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(71) Applicant: NELLCOR PURITAN BENNETT INCORPORATED [US/US]; 4180 Hacienda Drive, Pleasanton, CA 94588 (US).

(72) Inventors: SWEDLOW, David, B.; 2165 Canyon Oak Lane, Danville, CA 94506 (US). DALEO, Stephen, L.; 11498 Bay Laurel, Dublin, CA 94568 (US). YORKEY, Thomas, J.; 601 Bancroft Place, San Ramon, CA 94583 (US). RICHARDS, Edward, M.; 6693 Hansen Drive, Pleasanton, CA 94566 (US). PORGES, Charles; 61 Mira Loma Street, Orinda, CA 94563 (US). STUART, Charles; 4930 Dickinson Drive, San Jose, CA 95111 (US). NEMITS, Daniel, M.; 237 18th Street, San Francisco, CA 94121 (US). DELONZOR, Russell, L.; 25 Verbena Way, San Ramon, CA 94583 (US).

(74) Agents: HAUGHEY, Paul, C. et al.; Townsend and Townsend and Crew LLP, 8th floor, Two Embarcadero Center, San Francisco, CA 94111-3834 (US).

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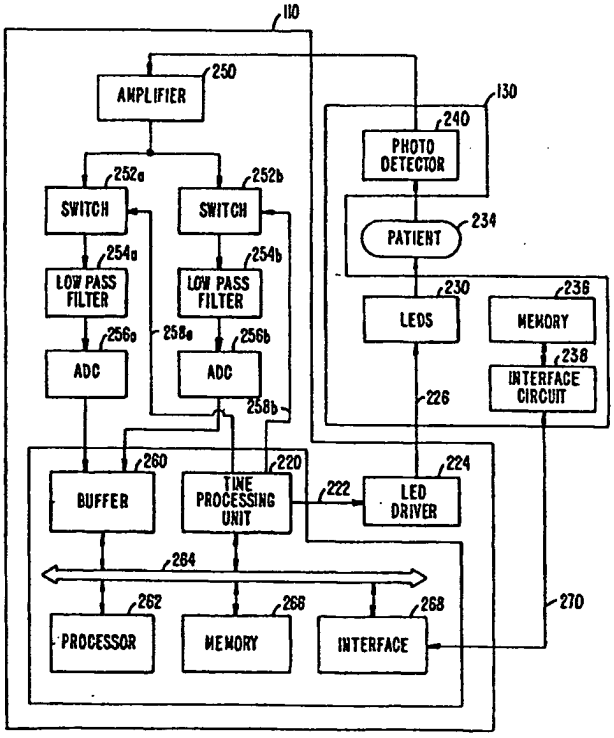
(57) Abstract

A mechanism for storing and providing historical physiological data, such as blood oxygen saturation data, for a patient. In particular, the historical physiological data is stored in a storage medium that "travels" with the patient and is accessible wherever the patient is moved. This is achieved by storing the physiological data within a sensor assembly. At the destination site, a monitor or a device capable of interfacing with the sensor electronics can retrieve and display the data. The historical physiological data allows a clinician or medical personnel at the destination site to assess the condition of the patient for the entire time that the patient has been monitored. Various types of physiological data can be stored including, but not limited to, blood oxygen saturation, heart rate, and temperature data. Compression of the data can be performed to enhance the storage capability.



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METHOD AND CIRCUIT FOR STORING AND PROVIDING HISTORICAL PHYSIOLOGICAL DATA

BACKGROUND OF THE INVENTION

The present invention relates to physiological test instruments and, in particular, sensors that include a mechanism for storing and providing to a monitor historical physiological data such as blood oxygen saturation data.

Pulse oximetry is typically used to measure various blood flow characteristics including, but not limited to, the blood oxygen saturation of hemoglobin in arterial blood, the volume of individual blood pulsation supplying a tissue, and the rate of blood pulsation corresponding to each heartbeat of a patient. Measurement of these characteristics has been accomplished by the use of a non-invasive sensor that passes light through a portion of a patient's blood perfused tissue and photo-electrically senses the absorption and scattering of light in such tissue. The amount of light absorbed is then used to estimate the amount of blood constituent in the tissue. The "pulse" in pulse oximetry comes from the time varying amount of arterial blood in the tissue during the cardiac cycle. The signal processed from the sensed optical signal is the familiar plethysmographic waveform due to cycling light attenuation.

To estimate blood oxygen saturation of a patient, conventional two-wavelength pulse oximeters emit light from two light emitting diodes (LEDs) into a pulsatile tissue bed and collect the transmitted light with a photodiode (or photo-detector) positioned on an opposite surface (i.e., for transmission pulse oximetry) or an adjacent surface (i.e., for reflectance pulse oximetry). One of the two LEDs' primary wavelength is selected at a point in the electromagnetic spectrum where the absorption of oxyhemoglobin (HbO_2) differs from the absorption of reduced hemoglobin (Hb). The second of the two LEDs' wavelength is selected at a different point in the spectrum where the absorption of Hb and Hb O_2 also differs from each other, and further differs from those at the first wavelength. Commercial pulse oximeters typically utilize one wavelength in the near red part of the visible spectrum near 660 nanometers (nm) and one in the near infrared (IR) part of the spectrum in the range of 880-940 nm.

Oxygen saturation can be estimated using various techniques. In one common technique, the photo-current generated by the photo-detector is conditioned and processed to determine the modulation ratio of the red to infrared signals. This modulation ratio has been observed to correlate well to arterial oxygen saturation. The pulse oximeters and sensors are empirically calibrated by measuring the modulation ratio over a range of in vivo measured arterial oxygen saturations (SaO_2) on a set of patients, healthy volunteers, or animals. The observed correlation is used in an inverse manner to estimate blood oxygen saturation (SpO_2) based on the measured value of modulation ratios of a patient. The estimation of oxygen saturation using modulation ratio is described in U.S. Patent No. 5,853,364, entitled "METHOD AND APPARATUS FOR ESTIMATING PHYSIOLOGICAL PARAMETERS USING MODEL-BASED ADAPTIVE FILTERING", issued December 29, 1998, and U.S. Patent No. 4,911,167, entitled "METHOD AND APPARATUS FOR DETECTING OPTICAL PULSES", issued March 27, 1990. The relationship between oxygen saturation and modulation ratio is further described in U.S. Patent No. 5,645,059, entitled "MEDICAL SENSOR WITH MODULATED ENCODING SCHEME," issued July 8, 1997. All three patents are assigned to the assignee of the present invention and incorporated herein by reference.

The LEDs and photo-detector are typically housed in a reusable or disposable oximeter sensor that couples to the pulse oximeter electronics and the display unit (hereinafter referred to as the monitor). The sensors are often connected to patients for long periods of time. Conventionally, historical physiological data for the patient is collected, if at all, by the monitor coupled to the sensor. The historical data can be valuable to a clinician or medical personnel for diagnostic and monitoring purposes.

Patients are often moved to various locations during treatment. For example, a patient may be picked up in an ambulance, delivered to an emergency room, moved to an operating room, transferred to a surgical recovery room, transferred to an intensive care unit, and then moved to a nursing floor or other locations. Thus, the patient may be moved between various locations within the same hospital, or between different hospitals. In many instances, the sensor employed to monitor the conditions of the patient is adhesive in their attachment and therefore remains with the patient. The monitors, however, are typically local to particular locations within the facility. The sensor is normally disconnected from the monitor at the departure site and reconnected to another monitor at the destination site. Consequently, any historical physiological data collected

by the monitor at the departure site is normally unavailable to the clinician attending the patient at the destination site.

In the medical art, a combination of a catheter sensor and a memory unit is disclosed in U.S. Patent No. 4,858,615, entitled "CATHETER SENSOR AND MEMORY UNIT," and issued August 22, 1989. In this patent, the sensor assembly (34) is located at a distal end of the catheter (32) and the memory unit (38) is connected by a multi-conductor lead (40) to the sensor (see Fig. 5). The catheter is an invasive instrument typically used at a particular location and removed during transport. Neither the catheter nor the memory unit would travel with the patient as he or she is moved to different locations. Thus, any data captured and stored in the memory unit (38) is also not available when the catheter is removed from the patient.

Accordingly, it is highly desirable to provide mechanisms for storing and providing historical physiological data that travels with a patient.

SUMMARY OF THE INVENTION

The invention provides a mechanism for storing and providing historical physiological data, such as blood oxygen saturation data, for a patient. In particular, the historical physiological data is stored in a storage medium that "travels" with the patient and is accessible wherever the patient is moved. This is achieved by storing the physiological data within the sensor assembly. At the destination site, a monitor or a device capable of interfacing with the sensor electronics can retrieve and display the data. The historical physiological data allows a clinician or medical personnel at the destination site to assess the condition of the patient for the entire time that the patient has been monitored. The invention can be used to store and provide various types of physiological data including, but not limited to, blood oxygen saturation, heart rate, and temperature data.

A specific embodiment of the invention provides a physiological sensor that includes a number of light sources, at least one photo-detector, and a memory circuit. The light sources are selected to operate at different wavelengths. The photo-detector receives light emitted by the plurality of light sources. And the memory circuit stores physiological data and provides the data when requested. The physiological data is indicative of a physiological condition of a patient being monitored by the sensor.

Another specific embodiment of the invention provides a physiological test instrument that includes a monitor and a sensor. The monitor includes conditioning circuitry and processing circuitry. The conditioning circuitry receives an electrical signal and processes the electrical signal to provide sampled data. The processing circuitry processes the sampled data to provide physiological data, wherein the physiological data is indicative of a physiological condition of a patient. The sensor couples to the monitor and includes a number of light sources, at least one photo-detector, and a memory circuit. The light sources are selected to operate at different wavelengths. The photo-detector receives light emitted by the light sources. The memory circuit stores the physiological data and provides the data when requested. An encoder can optionally be coupled to the processing circuitry to code and compress the physiological data before storage to the memory circuit. The test instrument can be an oximeter system for storing and providing historical saturation data of a patient.

Yet another specific embodiment of the invention provides a method for storing physiological data. The method detects, via a sensor, at least one signal indicative of a physiological condition and conditions the detected signal to generate data samples. The data samples are processed to generate the physiological data, wherein the physiological data describes the physiological condition. The physiological data is stored within a memory located within the sensor. The physiological data can be coded and compressed before storage to the memory.

The foregoing, together with other aspects of this invention, will become more apparent when referring to the following specification, claims, and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a simplified block diagram of an embodiment of a physiological measurement system;

Fig. 2 shows a block diagram of an embodiment of a monitor and a sensor; and

Fig. 3 shows a block diagram of one compression scheme for oxygen saturation data.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

Fig. 1 shows a simplified block diagram of an embodiment of a physiological measurement system 100. System 100 includes a monitor 110 that couples to a display unit 120 via an electrical cable 122. Monitor 110 further couples via a second electrical cable 128 to a sensor 130 that is applied to a patient 132. Sensor 130 includes light sources (e.g., LEDs) and a photo-detector along with suitable components to couple the electro-optical components to electrical cable 128. Sensor 130 is shown in Fig. 1 as a clip-on sensor. However, the invention can be applied to many sensor implementations, including those attached to a patient by adhesive and other attachment means. In a specific embodiment, monitor 110 is a pulse oximeter.

For estimating blood oxygen saturation, light from light sources at two or more wavelengths (e.g., red and infrared) is transmitted through a patient's blood perfused tissues (e.g., in a finger) and detected by a photo-detector. The selection of the wavelengths is based on a number of factors. Such factors include the absorption characteristics of the patient and transmission medium. The light sources and photo-detector are typically housed within a sensor that couples to the monitor (e.g., the pulse oximeter). The detected optical signal is then provided to the monitor for processing.

Fig. 2 shows a block diagram of an embodiment of monitor 110 and sensor 130. Within monitor 110, a time processing unit (TPU) 220 provides control signals 222 to an LED driver 224 that, via data line(s) 226, alternately activates LEDs 230 within sensor 130. Depending on the particular implementation, LEDs 230 include two or more LEDs and LED driver 224 provides the necessary drive signals for the LEDs. When activated, the light from LEDs 230 passes through a medium (e.g., air or a fiber optic cable, depending on the implementation) into a patient's tissues 234. After being transmitted through or reflected from the tissues, the light is received by a photo-detector 240 via another medium (e.g., air or another fiber optic cable). Photo-detector 240 converts the received light into a photo-current, which is then provided to an amplifier 250 that amplifies the photo-current.

As shown in Fig. 2, the amplified signal from amplifier 250 is provided to circuitry for two different channels, one channel for each of the red and infrared wavelengths. For a three-wavelength implementation, circuitry is provided for three channels. Each channel circuitry includes an analog switch 252 coupled in series with a low pass filter 254 that is further coupled in series with an analog-to-digital converter

(ADC) 256. Control lines 258 from time processing unit 220 select the sampled data from the channel corresponding to the LED being activated. Specifically, the sampled data from ADC 256a is selected when the red LED is activated and the sampled data from ADC 256b is selected when the infrared LED is activated. The sampled data from ADCs 256 is provided to a buffer 260 that stores the data for further processing. In an implementation, as buffer 260 periodically fills up, a processor 262 coupled to a bus 264 directs the transfer of the data from buffer 260 into a memory 266. The monitor implementation shown in Fig. 2 is one of many implementations. Another pulse oximeter implementation is disclosed in the aforementioned U.S. Patent No. 5,853,364. The present invention can be adapted for application in various monitor implementations.

The sensor of the invention further includes circuitry that stores historical physiological data and provides the data when requested. As shown in Fig. 2, sensor 130 includes a memory 236 coupled to an interface circuit 238. Interface circuit 238 provides signal conditioning, and can also provide other functions such as address decoding, and so on. Interface circuit 238 couples via a bus 270 to a data interface circuit 268 within monitor 110. Through interface circuits 238 and 268, physiological data is transferred between monitor 110 and sensor 130.

In an embodiment, to enhance compatibility of the sensor of the invention with conventional sensors and conventional monitors, bus 270 is implemented using new signal lines (i.e., not using or sharing the existing signal lines of conventional sensors). Bus 270 can be implemented as a serial bus, a parallel bus, or other bus architectures. With this implementation, when sensor 130 of the invention is plugged into a monitor not capable of supporting the features of the invention, the signals on interface circuit 238 are simply ignored by the monitor, or alternatively not requested by the monitor.

In another embodiment, interface circuits 238 and 268 interact via signal line(s) or wire(s) existing in conventional sensors and monitors. For example, interface circuits 238 and 268 can couple via data line(s) 226 and time multiplex with the LED drive signals from LED driver 224.

Time processing unit 220, buffer 260, processor 262, memory 266, and data interface circuit 268 can be implemented in various manners. For example, these elements can be implemented within a single integrated circuit, such as a DMC68HC16 micro-controller from Motorola. These elements can also be implemented within an

application specific integrated circuit (ASIC), a digital signal processor, a micro-controller, or other circuits.

Memory 236 can be implemented as a random access memory (RAM), a FLASH memory, a programmable read only memory (PROM), an erasable PROM (EPROM), an electrically erasable PROM (EEPROM), a similar programmable and/or erasable memory, any kind of erasable memory, a write once memory, or other memory technologies capable of write operations. Memory 236 and interface circuit 238 can be integrated within one integrated circuit for reduced size and cost.

In a specific embodiment, to preserve the historical data and prevent accidental erasure, the sensor memory can be written once. This memory characteristic also prevents erasure of the data during sensor processing. A specific example of a memory device that can be written once is a 2-wire EPROM device available from Dallas Semiconductor Corp.

In another embodiment, the memory can be erased and overwritten multiple times. This memory characteristic may be advantageous, for example, for non-disposable sensors that may include a large amount of memory. Such "specialty" sensors may be better suited for applications where there is a higher propensity to use reusable sensors, such as inside an operating room or an intensive care unit or during an ambulance transport. Specific examples of memory devices that can be erased and overwritten are Flash, EEPOM, battery backed RAM, and other technologies.

The invention is applicable for various oximeter system implementations. For example, in an embodiment, an adapter module and a fiber optic cable can be interposed between cable 128 and sensor 130 (see Fig. 1). The adapter module can include the light sources, the detector, and suitable optics to couple the electro-optical components to the fiber optic cable that guides light to and receives light from the patient. The fiber optic cable can also be partitioned into a long extension cable and a relatively short "sensor" cable. The fiber optic cables can be either glass or plastic fiber. This embodiment allows the electro-optical components to be reused, and only the short sensor cable is replaced from patient to patient.

Fig. 2 shows an oximeter implementation using light at two wavelengths. However, light from more than two LEDs can be used (i.e., for improved accuracy). Light from a single light source can also be used, typically along with appropriate optical filter. Moreover, light sources other than LEDs can be used. For example, lasers or white

light sources can be used with appropriate filters at either the transmitting or receiving end.

The sensor can include different numbers of elements, depending on the implementation of the sensor or the application for which the sensor is used. In one implementation, the sensor includes the LEDs and the photo-detector. This implementation reduces the transmission loss by placing the light source and the detector near the patient. In another implementation, the sensor includes only the transmission medium (e.g., a short fiber optic cable), but no LEDs or photo-detector. This implementation reduces cost, since the LEDs and photo-detector are included within an adapter module and are reusable. In yet another implementation, the sensor can include either the LEDs or the photo-detector, as a compromise to reduce cost and transmission loss. For these various variations, the sensor includes the memory for storing historical physiological data.

During normal operation, when the sensor is plugged into the monitor, the monitor receives the signal from the photo-detector within the sensor and processes this signal to obtain the desired physiological data. In some conventional monitors, the physiological data is stored in a memory within the monitor and retrieved at a later time when requested. However, when a patient is moved to new locations and different monitors are used, the data stored in the monitor at the previous site is typically not available at the current site.

In accordance with the invention, the physiological data is processed, displayed, and stored in the monitor in the nominal manner. In addition, the data is compressed and provided to the sensor for storage in a memory 236 located within the sensor. When the sensor is plugged into another monitor, the new monitor can retrieve the data stored in the sensor memory, decompress the retrieved data, and display the decompressed data. In an embodiment, when the sensor is first plugged into a new monitor, the monitor retrieves and displays the historical physiological data for the most recent predetermined period (i.e., the last 20 or 30 minutes). This predetermined period can be programmed by the clinician or can be preprogrammed into the sensor memory.

Alternatively, the monitor can be configured to retrieve and display the historical physiological data at any time upon request by a health care giver (or a clinician), by the health care giver simply activating a control knob on the monitor. The control knob optionally can be preset so as to automatically retrieve the data upon

occurrence of a predetermined event, such as a sensor being plugged into the monitor, or can by preconfigured so that the data is only retrieved upon explicit command by a health care giver.

As noted above, the invention can be used to store and provide various physiological data including, but not limited to, blood oxygen saturation and heart rate data. For clarity, the invention is described in the context of the storage and retrieval of blood oxygen saturation (SpO_2) data. Based on the received signals representative of the intensity of the light detected by photo-detector 240, processor 262 estimates oxygen saturation using algorithms that are known in the art. These algorithms utilize calibration coefficients that may be empirically determined and correspond to, for example, the wavelengths of the lights used.

The saturation data for a particular patient is processed by the monitor attached to the sensor, and the processed data is provided to the sensor for storage in the sensor memory. The selection of the sensor memory is dependent on numerous factors including cost, the amount of data that needs to be stored for a particular application, the amount of achievable data compression, the physical dimensions, and so on. For oxygen saturation, storage of approximately seven days of historical data is adequate for many applications.

In an embodiment, to reduce the amount of data to be stored in the sensor memory, the physiological data is compressed before storage. In an embodiment, the compression is performed by facilities located within the monitor. Alternatively, the encoding circuit can be on the sensor itself. The monitor further includes facilities to decompress the data retrieved from the sensor memory. Compression allows for the use of a smaller-sized memory in the sensor. This is particularly advantageous since the sensor is typically disposed after use on a patient. Compression also allows more data to be stored into a memory of a given size. The ability to store large amount of data is important for many diagnostic applications that require data collected over hours or days.

The compression scheme can be designed to take advantage of known characteristics of the physiological data being stored. For example, it is known that oxygen saturation generally do not change rapidly. This characteristic can be exploited to achieve significant compression, as described below.

Fig. 3 shows a block diagram of one compression scheme for oxygen saturation data. The saturation data is provided to a filter 312 that filters the data. The

filtered data is provided to a differential pulse code encoder (DPCM) 314 that determines difference values between successive filtered data samples. The difference data is provided to a quantizer 316 that "re-quantizes" the difference data. The quantized data is provided to a run-length coder (RLC) 318 that codes the quantized data using an efficient set of codes. Each of these elements is further described below.

In an embodiment, since it is known that oxygen saturation does not change rapidly, the saturation data is averaged over a predetermined time period (herein referred to as an epoch) and one averaged saturation sample is provided as representative of the saturation during that epoch. In a specific embodiment, an epoch is a time period having a duration of one to five minutes, although any different duration can be used. The epoch can also be set based on the characteristics of the physiological data being stored (i.e., a longer epoch for slow changing physiological data and a shorter epoch for fast changing data).

Filter 312 filters the saturation data. Filter 312 can be a digital filter designed in a manner known in the art. In an embodiment, filter 312 is a lowpass filter having a bandwidth related to the epoch (i.e., $BW \approx \alpha / t_{EPOCH}$, where BW is the filter bandwidth, α is a proportionality constant, and t_{EPOCH} is the period of an epoch. The characteristics of filter 312 can also be equalized (i.e., spectrally shaped) to match the characteristics of the data being filtered.

To further smooth the data and increase the amount of compression, the saturation data can be filtered over a period of several epochs. However, averaging the saturation data over a longer time interval masks rapid changes in saturation, which are smoothed out and lost in the averaging process. To capture rapid change events, a moving average filter can be used.

In an embodiment, the moving average filter includes a filter that filters the saturation data over an epoch (i.e., a single-epoch filter) and another filter that filters the data over multiple epochs (i.e., a multiple-epoch filter). The moving average filter monitors the averaged saturation data from the single-epoch filter and detects averaged saturation samples that fall outside a predetermined window. The predetermined window can be set at plus and minus several saturation points around the current averaged saturation value. For example, if the current averaged saturation sample has a value of 90 saturation points, the predetermined window can be set at ±2 saturation points centered

around 90 (e.g., 88 to 92). The moving average filter then activates a flag if the next averaged saturation sample has a value below 88 or greater than 92. If the averaged saturation sample from the single-epoch filter is within the window, the averaged sample from the multiple-epoch filter is used. Otherwise, an averaged saturation sample from the single-epoch filter falling outside the window indicates a rapid change in saturation. This detected sample is used to restart the moving average and cause a change of the averaged saturation sample to the new value from the single-epoch filter. The moving average filter allows for the detection of rapid changes and the capture of their magnitudes while maintaining a filtered data stream that enhances compression of nominal data.

The slow varying nature of oxygen saturation suggests the use of differential coding since less bits would be required to represent the differences between samples than the actual sample values. With differential coding, the first saturation sample is stored using the actual sample value. A subsequent saturation sample is represented as a delta value from a preceding saturation sample. Periodically, the actual sample value is stored to prevent an accumulation of error in the differential coding and to limit the propagation of error. DPCM 314 determines the difference values between successive saturation samples. The difference value is calculated by subtracting the current saturation sample from a preceding saturation sample.

For many applications, it is not necessary to store saturation data with a great deal of precision. For example, for some applications, it is sufficient and acceptable to indicate a change of ± one saturation point as no change in saturation. Thus, the difference values from DPCM 314 can be re-quantized by quantizer 316.

In an embodiment, quantizer 316 is a window comparator having a quantization window of, for example, ± one saturation point. If the difference value falls within the quantization window, quantizer 316 indicates a "no change" in saturation and outputs a zero. If the difference value falls outside the quantization window, quantizer 316 passes this value without additional processing. Quantizer 316 can also be implemented in other manners, for example, as a quantizer having a step size twice that of the saturation sample.

Requantization by quantizer 316 introduces quantization error in the reconstructed data. This error can accumulate over successive samples and exceed an acceptable threshold. To avoid this phenomenon, an error accumulator 320 coupled to

quantizer 316 accumulates the error introduced by quantizer 316 and provides the accumulated error to DPCM 314. DPCM 314 takes the accumulated error into account when calculating the difference values.

Because of the slow varying nature of oxygen saturation and the use of differential coding and requantization, many of the data values from quantizer 316 are zero. In an embodiment, run length coder (RLC) 318 receives the quantized data from quantizer 316, transmits the non-zero values, and sends a code representative of the number of zero values between the non-zero values. For example, for a sequence of (3, 0, 0, 0, 0, 0, 0, 4, ...), RLC 318 transmits the first "3", then a code indicating six consecutive zeros, then "4". In an embodiment, the code representative of the number of consecutive zeros are generated such that the most likely sequences of consecutive zeros are assigned codes having shorter code widths, and the more unlikely sequences are assigned codes having longer code widths. This code characteristic is similar to that of a Huffman code that is known in the art.

The elements shown in Fig. 3 can be implemented in various manners. For example, these elements can be implemented within a processor (i.e., processor 262 in Fig. 2), a digital signal processor, an ASIC, or other circuits. The functions of the elements in Fig. 3 can also be provided by a program code executed on processor 262 with the supported of memory 266.

Fig. 3 shows one compression embodiment. In another compression embodiment, the non-zero difference values are transmitted along with their epoch numbers. For the sequence shown above, the transmitted values may be (3, 1), (4, 8), and so on. The first number in the pair is the difference value and the second number is the epoch number. For some applications, this embodiment may provide additional compression over the embodiment shown in Fig. 3.

In yet another compression embodiment, the saturation value and the number of epochs over which the value is within a predetermined quantization window are recorded. In this embodiment, it is not necessary to compute the difference values. Again, this embodiment may significantly reduce the data storage requirement for some type of physiological data.

Several compression embodiments have been described for oxygen saturation data. Although the invention can be practiced without the use of compression, additional capabilities are provided by the judicious use of compression. As used herein,

compression includes any processing that alters, however slightly, the original form of the physiological data as they are generated (in the nominal manner) by the monitor. Other compression schemes can also be used and are within the scope of the invention. Of course, no compression could optionally be used.

Additional data besides oxygen saturation data can be stored in the sensor memory (i.e., to assist in diagnostics or monitoring of patients). For example, a time stamp of the data can be stored. In this case, the first data sample includes the specific time (e.g., date and time) when the data is recorded. Subsequent data samples can be indicated by the number of epochs away from the first (or a previous) data sample. The sensor memory can also store an indication of a disconnection of the sensor from the monitor. This data allows the clinician or medical personnel to delineate the events retrieved from the sensor memory.

The sensor memory can also include a field that indicates when the sensor memory is full. The information in this field can be provided to the monitor to direct the monitor to cease sending data to the sensor memory. The information in this field can be prominently displayed by the monitor to notify the clinician or medical personnel. Also, in response, the monitor can generate an alarm (i.e., blinking light or an audio alarm, or both) to draw the attention of the clinician to the operating state of the sensor.

In a specific embodiment, the saturation data is stored in a data format that includes an N-bit data field and a field containing the number of epochs over which the data value is maintained. However, many other data formats can be used and are within the scope of the invention.

As noted above, in a specific embodiment, the sensor memory is implemented as a write-once memory device. A field in the sensor memory can be set when the sensor is reprocessed so that the monitor can determine that it is coupled to a reprocessed sensor. The monitor can use the information in this field to disable the display of the historical data (for example, if the memory is write once and relatively full). Alternatively, if the memory is erasable, a field for storing historical physiological data could be erased during sensor reprocessing.

Disabling the data display may be preferable in some applications to ensure the integrity of the collected data. For a memory device that can be written once and has a fixed memory size, it may not be possible to determine where the "old" data came from or how much memory may still be available on a reprocessed sensor.

Moreover, it is highly desirable to avoid having data from an old patient being displayed and potentially mistaken as valid data for the patient to which the sensor couples. Since it is not easy to control or determine the amount of available unwritten memory after a use, which can vary from zero to the full amount, inconsistency and potential customer dissatisfaction may result from using a sensor having widely varying amounts of available memory. By not displaying data from reprocessed sensors, these potential problems are avoided.

The invention has been described for the storage of blood oxygen saturation data. However, the sensor memory can also store data for other physiological characteristics such as, for example, heart beat, temperature, and so on. For example, anything, the sensor memory can be used to store NIBP, IBP, and ECG waveforms. Moreover, as memory costs continue to fall and larger memories become available, more complex physiological parameters can be measured and stored.

Additionally, information about the monitor can be stored or embedded along with the physiological data. This additional information may include, for example, the serial number of the monitor to which the sensor couples, the sensor connect/disconnect times, monitor diagnostics, and others. This information would allow the clinician access to historical information on the instrument as well as the physiological data, which might be useful, for example, in litigation or in troubleshooting and instrument.

The invention provides advantages not available in conventional monitors and sensors. For example, the invention allows for monitoring of a patient in transit who may be connected to two or more monitors over a period of time. One such situation is a patient who is transported in an ambulance to an emergency room and later transferred to an intensive care unit. The invention is especially beneficial in this application since this particular patient is more likely to be in need of close monitoring.

The invention can also be used to document physiological characteristics. For example, for a patient in home care who requires oxygen, documentation of oxygen saturation is typically needed. In this case, the sensor of the invention can be used to store saturation data for the patient over a predetermined time period (i.e., one week). At the end of this period, the caregiver can simply remove the sensor and sends it away as documentation of the patient's saturation. The invention can also be used to collect data for other applications such as, for example, sleep diagnostics, de-saturation, and so on.

The sensor of the invention has been described for use in combination with a monitor that performs the signal processing of the detected signal and compression of the processed data. In another embodiment, the sensor of the invention includes the facility to process (and compress, if necessary or desirable) the detected signal. This embodiment advantageously allows for independent operation of the sensor without support from a monitor. The data stored within the sensor can be provided to a monitor for display. The amount of signal processing and compression that can be achieved by circuitry within the sensor is only limited by the available technology, which inevitably improves over time. In the near term, physiological data that does not require extensive signal processing and compression (e.g., temperature, peak amplitude in a waveform, heart rate, and so on) can be collected and stored by the sensor.

For further understanding of the invention in its use for the storage of blood oxygen saturation data, a description of the derivation of oxygen saturation from photo-detected signals is included in the aforementioned U.S. Patent Nos. 4,911,167, 5,645,059, and 5,853,364.

The data stored can correspond to a value of an actual physiological condition (i.e., oxygen saturation) or can be indicative of the condition value with the condition value being determinable by the monitor upon reference to a look-up table or by the monitor calculating the condition value from the stored data using a predetermined algorithm.

The previous description of the preferred embodiments is provided to enable any person skilled in the art to make or use the present invention. The various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. For example, the invention can be applied to the storage of other physiological data, such as data for a patient's heartbeat, temperature, volume of individual blood pulsation supplying the tissue or the rate of blood pulsation, and so on. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

WHAT IS CLAIMED IS:

1. A physiological sensor for connecting to a remote monitor, comprising:

means for obtaining signals from a patient indicative of a physiological condition of the patient;

means for sending the signals to the remote monitor; and

a memory circuit associated with the sensor that stores patient physiological data derived from the signals and indicative of the physiological condition and provides the data to a remote device when requested by the device.

2. The sensor of claim 1 further comprising:

an interface circuit coupled to the memory circuit, wherein the interface circuit facilitates data transfer to and from the memory circuit.

3. The sensor of claim 1 wherein the memory circuit is implemented as a write-once memory, a FLASH memory, a random access memory (RAM), an erasable memory, or an electrically erasable programmable read only memory (EEPROM).

4. The sensor of claim 1 wherein the memory circuit is implemented as a multiple writes memory.

5. The sensor of claim 1 wherein the physiological data includes blood oxygen saturation data.

6. The sensor of claim 5 wherein the physiological data includes pulse rate data.

7. The sensor of claim 1 wherein the physiological data is compressed before storage to the memory circuit.

8. The sensor of claim 7 wherein the physiological data is compressed using either differential coding or run length coding.

9. The sensor of claim 7 wherein the physiological data is uncompressed when stored on the memory circuit.

10. The sensor of claim 1 wherein the physiological data is subsampled to provide one data sample for each epoch, wherein an epoch is a predetermined time period selected, in part, based on characteristics of physiological data being stored.

11. The sensor of claim 1 wherein the memory circuit provides information that indicates when the memory circuit is full.

12. The sensor of claim 1 wherein the memory circuit further stores information of a time associated with each of specific samples of the physiological data.

13. The sensor of claim 1 wherein the memory circuit further stores information indicative of disconnection of the sensor from a monitor.

14. A physiological sensor for connection to a remote monitor, comprising:

at least one light sources, each light source is selected to operate at a different wavelength;

at least one photo-detector operative to receive light emitted by the at least one light source;

a memory circuit that stores physiological data and provides the data when requested, wherein the physiological data is indicative of a physiological condition of a patient being monitored by the sensor; and

an interface circuit coupled to the memory circuit, wherein the interface circuit coordinates data transfer to and from the memory circuit.

15. A method for storing physiological data comprising:

detecting via a sensor at least one signal indicative of a physiological condition;

conditioning the detected at least one signal to generate data samples;

processing the data samples to generate the physiological data, wherein the physiological data describes the physiological condition; and

storing the physiological data within a memory located within the sensor.

16. The method of claim 15 further comprising;
coding the physiological data to generate compressed physiological data.

17. The method of claim 15 further comprising;
sampling or preprocessing the physiological data to generate compressed physiological data.

18. The method of claim 15 wherein the physiological data includes blood oxygen saturation data.

19. A physiological test instrument comprising:
a monitor including
conditioning circuitry that receives an electrical signal and processes the electrical signal to provide sampled data, and
processing circuitry that processes the sampled data to provide physiological data, wherein the physiological data is indicative of a physiological condition of a patient; and
a sensor coupled to the monitor, wherein the sensor includes
at least one light sources, each light source is selected to operate at a different wavelength,
at least one photo-detector operative to receive light emitted by the at least one light source, and
a memory circuit that stores at least some of the physiological data and provides the data when requested.

20. The test instrument of claim 19 wherein the monitor further includes means responsive to a user input for transferring the at least some of the physiological data to the sensory memory circuit in response to user input.

21. The test instrument of claim 19 wherein the monitor further includes means responsive to an oxygen desaturation event for transferring the at least some of the

physiological data to the sensory memory circuit in response to an oxygen desaturation event of the patient.

22. The test instrument of claim 19 wherein the monitor further includes means responsive to a threshold crossing for transferring the at least some of the physiological data to the sensory memory circuit when an oxygen saturation of the patient differs by more than a predetermined amount from a previous oxygen saturation of the patient.

23. The test instrument of claim 19 wherein the monitor further includes an encoder coupled to the processing circuitry, wherein the encoder codes the physiological data to provide compressed physiological data.

24. The test instrument of claim 23 wherein the monitor further includes a decoder that receives compressed physiological data from the memory circuit and decodes the data.

25. The test instrument of claim 19 wherein the physiological data includes blood oxygen saturation data.

26. An oximeter system for storing and providing historical saturation data of a patient comprising:

two or more light sources for transmitting light through the patient, wherein the light sources operate at different wavelengths;

a detector that detects optical signals from the light sources and provides electrical signals indicative of the detected optical signals;

conditioning circuitry that processes the electrical signals to provide data samples corresponding to the electrical signals;

processing circuit that receives the data samples and processes the data samples to provide saturation data;

a memory within a sensor that stores the saturation data; and

circuitry that retrieves the stored saturation data and directs display of the saturation data.

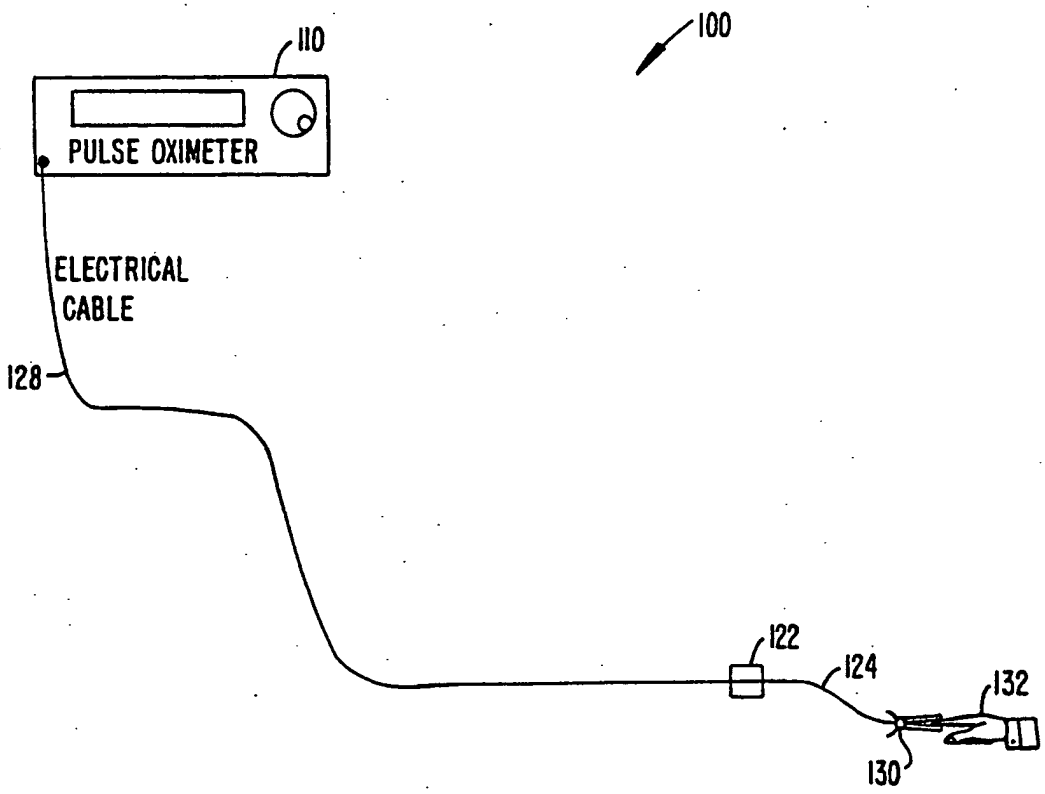
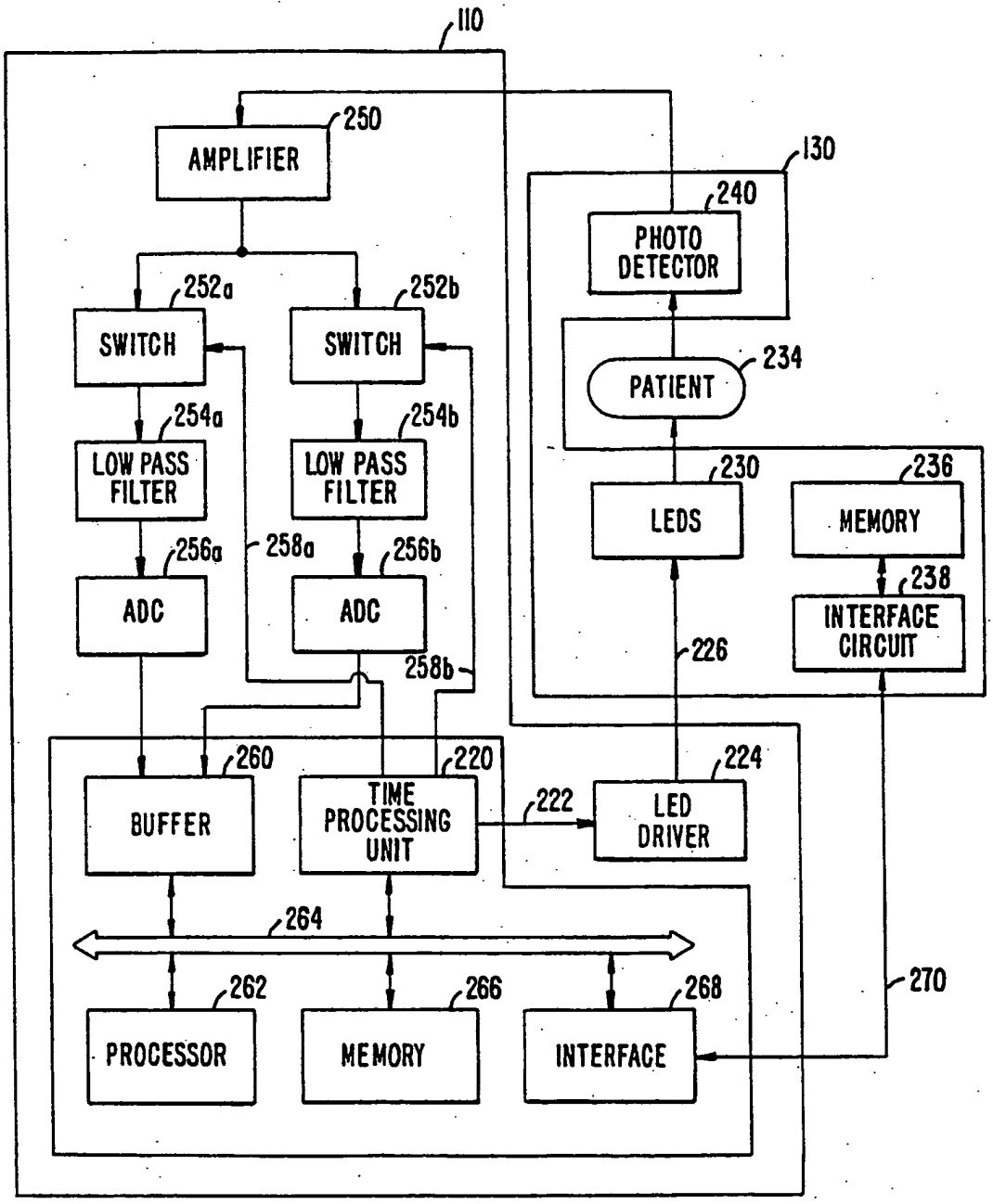


FIG. 1.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SWITCH
SWITCH
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PATIENT
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LOW PASS FILTER
LOW PASS FILTER
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236
LEDS
MEMORY
256a
258a
256b
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ADC
ADC
INTERFACE CIRCUIT
226
258b
260
220
224
BUFFER
TIME PROCESSING UNIT
222
LED DRIVER
264
262
266
268
270
PROCESSOR
MEMORY
INTERFACE

FIG. 2.

INTERNATIONAL SEARCH REPORT

Inte ɔnal Application No
PCT/US 00/05892

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A61B5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 827 943 A (ROBERT) 9 May 1989 (1989-05-09) the whole document	1-26
Y	US 5 758 644 A (MASIMO) 2 June 1998 (1998-06-02) the whole document	1-26

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Lemercier, D

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter nal Application No
PCT/US 00/05892

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		WO 8802237 A	07-04-1988
US 5758644 A	02-06-1998	AU 4106599 A	21-10-1999
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		US 5823950 A	20-10-1998

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(71) Applicant: CLINICOMP INTERNATIONAL, INC. [US/US]; 9655 Towne Centre Drive, San Diego, CA 92121 (US).

(72) Inventor: HAUDENSCHILD, Chris, A.; 1769 La Jolla Rancho Road, La Jolla, CA 92037 (US).

(74) Agent: KLEINKE, Bernard, L.; Higgs, Fletcher & Mack, LLP, Suite 2600, 401 West "A" Street, San Diego, CA 92101 (US).

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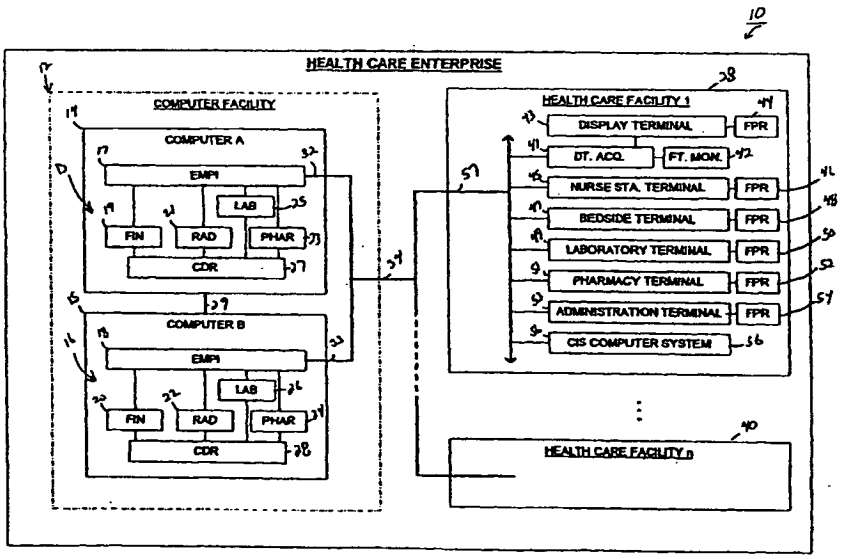
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ENTERPRISE HEALTHCARE MANAGEMENT SYSTEM AND METHOD OF USING SAME



(57) Abstract: A healthcare management system (10) includes a server system (12) connected to a plurality of enterprise facilities (38, 40) through a network (34). A master index (17, 18) and a shared document repository on the server (12) facilitate positively identifying patients and confidently associating patients with proper medical records. Healthcare practitioners also use the healthcare management system (10) to access a patient treatment plan system, irrespective of which enterprise facilities (38, 40) presently have the patient or which enterprise treatment plan operates the patient treatment plan.

WO 01/08077 A1

ENTERPRISE HEALTHCARE MANAGEMENT SYSTEM AND METHOD OF USING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part patent application of U.S. patent application no. _____, filed June 30, 1999, and entitled "ENTERPRISE HEALTHCARE MANAGEMENT SYSTEM AND METHOD OF USING SAME," which is a continuation-in-part patent application of U.S. patent application no. 08/977,522, filed November 24, 1997, and entitled "CLINICAL CRITICAL CARE PATH SYSTEM AND METHOD OF USING SAME," which are incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

REFERENCE TO A "MICROFICHE APPENDIX"

Not Applicable

BACKGROUND OF THE INVENTION

Technical Field

The field of the present invention is healthcare management systems for healthcare enterprises. More specifically, the present invention relates to providing software applications for use by healthcare enterprises having a plurality of facilities.

Background Art

Modernly, primary healthcare is often times provided by healthcare enterprises. A healthcare enterprise is a group of healthcare facilities including, for example, hospitals, laboratories, pharmacies, and others. Healthcare enterprises can be expansive, encompassing hundreds of doctors and many geographically widely dispersed point of care facilities. Alternatively, they can be more modest in size having just a few facilities.

However, no matter what the size of the enterprise, all healthcare enterprises are coming under increased pressure to improve patient care without incurring undue additional expense. Indeed, successful healthcare enterprises must become more efficient and effective in providing patient services to remain viable. Thus,

enterprises are striving to increase efficiency, while maintaining or improving patient care. For example, healthcare facilities are merging to form larger enterprises. In such a manner, the larger healthcare enterprises hope to improve efficiency through economy of scale.

Most healthcare enterprises have computer systems, and many have established local area networks within their facilities. The established computer systems typically perform a variety of particular and discrete functions. For example, a facility may have a clinical information system as described in U.S. patent application 08/977,522 for managing and presenting patient care management plans. The hospital may have other systems for financial and administrative functions. However, many of these established computer systems are unable to provide the information required to support healthcare enterprises in the modern managed care environment in an efficient and economical manner.

Further, each facility may have computer systems that operate differently and store information in diverse formats. Thus, information from different facilities of the same enterprise may not be readily usable by another

NOT FURNISHED UPON FILING

effective process for associating a patient with a medical file in an accurate and efficient manner. If such a positive identification can not be made, then proper medical treatment may be delayed, or worse, an incorrect treatment may be provided to the patient.

A healthcare enterprise having multiple facilities may encounter several problems when admitting a patient. For example, it would be helpful to know whether or not the patient to be admitted is a current patient or had been previously admitted at any of the facilities of the same enterprise. Since each of the facilities may be using record management features incompatible with the other facilities, there is no efficient manner to find if a patient had been previously admitted to the same enterprise.

Confidently identifying the to-be-admitted patient can be a daunting task. However, it is critical that the patient be positively associated with their true and complete medical record, if available. Such an identification task is exacerbated if the patient is unconscious. In such a manner, the person admitting the patient must rely solely on anecdotal information to establish the identity of the patient. Thus, the actual

identity of the patient may not be established, or an incorrect identity made. Either way, providing treatment for the patient is difficult and may even result in harmful delays or treatment for the patient.

Once a patient has been successfully admitted to a multi-facility enterprise, then it is typical for several practitioners to become involved in providing healthcare to that patient. For example, doctors, nurses, laboratory technicians, radiologists, and pharmacists are needed to implement a successful treatment plan. However, these healthcare providers may be located in separate facilities, which may be widely dispersed geographically.

In providing healthcare to a patient, it is highly desirable that a complete medical history be available to healthcare practitioners. However, in the modern healthcare environment, patients routinely are transferred to different facilities of the same enterprise. Thus, over a period of years a patient's medical record becomes fragmented and dispersed among the various facilities of an enterprise.

Therefore, in general, it would be highly desirable to have a new computerized system for more efficiently and

effectively communicating patient information among the various facilities of a healthcare enterprise.

The new system further needs to be quickly and confidently installed without burdensome expense to the enterprise. It is also desirable that existing legacy applications, computers, and networks cooperate with the new system. In such a manner the enterprise preserves prior information technology investments.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a new enterprise healthcare management system for providing improved communication between healthcare facilities.

In another separate object of the present invention the new healthcare management system should enable a remote practitioner to easily access or modify a patient's complete chart.

Briefly, the above and further objects are realized by providing a new enterprise healthcare management system and method of using same. The enterprise healthcare management system and method includes a novel healthcare management system. The healthcare management system includes a server system connected to a plurality of enterprise facilities.

A master index and a shared document repository on the server facilitate positively identifying patients and confidently associating that patient with proper medical records. The method of using the system also facilitates finding where in the enterprise a patient is located, and identifying available patient records. Healthcare practitioners also use the healthcare management system to access a patient treatment plan system, irrespective of which enterprise facility presently has the patient or which enterprise treatment plan system operates the patient treatment plan.

Advantageously, the new healthcare management system facilitates a healthcare enterprise's positively identifying patients and associating the identified patient with that patient's records. In such manner a patient can be admitted to an enterprise facility more efficiently. Further, as a patient moves to different locations and facilities within the enterprise, practitioners can confidently identify the patient prior to administering treatment. Therefore, the quality of delivered healthcare is improved.

The healthcare management system also enables a practitioner to quickly find where a patient is located in

the enterprise, and determine what records exist and where the records can be found. By enabling such easy access to complete information, the healthcare management system allows the healthcare enterprise to operate more efficiently.

Further, the healthcare management system enables a practitioner at any enterprise facility to seamlessly use the treatment plan system for any enterprise patient. Thus, remote practitioners can efficiently access patient treatment plans so that the practitioner can review, adjust, and implement patient treatment plans.

The new healthcare management system also easily adjusts to changes within the enterprise. As the enterprise grows, adds facilities, sells facilities, and changes, the new system easily and cost effectively scales to facilitate the new level of need.

BRIEF DESCRIPTION OF DRAWINGS

The above mentioned and other objects and features of this invention and the manner of attaining them will become apparent, and the invention itself will be best understood by reference to the following description of the embodiment

of the invention in conjunction with the accompanying drawings, wherein:

FIG. 1 is a block diagram showing a healthcare enterprise made in accordance with the present invention; and having multiple facilities;

FIG. 2 is a block diagram of a multiple enterprise healthcare system made in accordance with the present invention showing the interconnection of a plurality of healthcare enterprises;

FIG. 3 is a flowchart of a method enterprise in accordance with the present invention for admitting a patient to a healthcare;

FIG. 4 is a continuation flowchart of FIG. 3;

FIG. 5 is a flowchart of a method in accordance with the present invention for finding a patient at a healthcare enterprise;

FIG. 6 is a flowchart of a method in accordance with the present invention for accessing a CIS system for a patient;

FIG. 7 is a flowchart of a method in accordance with the present invention for admitting a patient into a healthcare facility;

FIG. 8 is a continuation flowchart of FIG. 7; and

FIG. 9 is a flowchart of a method in accordance to the present invention for installing a healthcare facility management system.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring now to the drawings, and more particularly to FIG. 1 thereof, there is shown a new healthcare management system 10 which is constructed in accordance with the present invention. The healthcare management system 10 is for use in healthcare enterprises comprising two or more facilities. These facilities, for example, may provide a point of care for healthcare patients.

The healthcare management system 10 generally comprises a redundant server system 12 which is connected via a network 34 to the healthcare facilities 38 and 40. Thereby, healthcare practitioners in the healthcare facility, such as healthcare facility 38, access the server system 12 from terminals. Each healthcare facility may be operating its own clinical information system (CIS) computer system 56. The CIS system provides, for example, the implementation of treatment plans for patients, as more fully addressed in the patient applications. Although each facility has a separate CIS system, the server system 12

has an enterprise master patient index (EMPI) 17 and 18 for storing patient identifiers from all healthcare facilities. In such a manner, a health practitioner at any healthcare facility can find and retrieve information on any enterprise patient irrespective of which facility the patient is currently located.

In operation the server system 12 operates a suite of healthcare software applications 13 and 16 for providing software applications for the facilities of the healthcare enterprise. Associated with the suite of applications 13 and 16 is a common document repository (CDR) 27 and 28 for providing commonly accessible storage areas for all healthcare facilities. Further, the EMPI 17 and 18 store patient identifiers which are accessible at all enterprise facilities.

Additionally, the EMPI 17 and 18 may contain authorization information related to healthcare practitioners. For example, a nurse practitioner may approach nursing station terminal 45 and desire to view a particular patient's medical record. The nurse enters basic authorization information into the nurse's station terminal 45 which is received at the server system 12 and compare to authorization information within the EMPI.

Provided the nurse initially appears to be a valid user, the nurse will be prompted to place his/her finger onto fingerprint reader 46. The fingerprint reader 46 scans the nurse's finger to record a fingerprint pattern. Information indicative of the fingerprint pattern is also sent to the server system 12 where it is compared to fingerprint pattern information stored in the EMPI. If the nurse is a valid user of the system, and has authorization proper for the requested action, the server system 12 allows the nurse to proceed with the desired action.

The nurse at nurse's station 45 may then enter patient specific information into the nurse's station terminal 45. The patient specific information is received at the server system 12 where the patient specific information is compared to the patient identifiers within the EMPI 17 and 18. If inconclusive patient specific information has been entered, the EMPI may identify several patients substantially matching the received patient's specific information. Thereby, the server system 12 retrieves further patient information for each identified possible match and forwards the more complete patient information back to the nurse's station terminal 45. The nurse then reviews the received more complete medical records and

selects with confidence the medical record for the patient at issue. In such a manner the nurse positively identifies a patient and associates the patient to their true medical record file.

With the healthcare management system 10 generally described, component parts will now be discussed in more detail. The server system 12 is a redundant computer system having computer A 14 and computer B 15. Computer A 14 is connected to computer B 15 via redundant link 29. In such a manner, both computer A and computer B operate simultaneously to assure that each is running properly. If one of the computers fails, then the failing computer is shut down and the remaining redundant computer continues on, thereby providing service in an uninterrupted manner. The installation and use of redundant computer systems is well known in the art.

Both computer A 14 and computer B 15 operate a suite of healthcare applications 13 and 16. The suite may include financial software 19 and 20, radiology software 21 and 22, laboratory software 25 and 26, and pharmacy software 23 and 24. Although four applications are identified, those skilled in the art will recognize other applications may be substituted or supplemented. Each of

computer 14 and 15 has a CDR data base 27 and 28 for storing information in a manner such that the information can be shared between suite applications. In such a manner, multi-disciplinary information may be retrieved from the CDR 27 and 28. Further, the CDR 27 and 28 contains information received from applications operating at the healthcare facilities 38 and 40. For example, healthcare facility 1 38 has a computer system operating a CIS system 56. Patient care information from CIS computer system 56 is sent to server system 12 where it is stored on the CDR 27 and 28. In such a manner, healthcare practitioners at any healthcare facility 38 and 40 can retrieve and review documents stored on the CDR relating to the CIS computer system 56.

Both computer A 14 and computer B 15 have an EMPI file. The EMPI file is the master index for accessing the server system 12 and finding patients and patient information. The patient identifier information include identifying characteristics for identifying patients with a high degree of certainty. Such patient identifiers may include name, birth date, social security number, birth date, gender, fingerprint pattern data, or race. Those skilled in the art will recognize other identifiers may be

used. The EMPI thereby stores patient identifiers for all patients of the healthcare enterprise. Thus, irrespective of which facility admits a patient, patient information is stored in a common and accessible format. Subsequently, information related to that patient can then be found and retrieved by any healthcare practitioner from any healthcare facility within the enterprise. Indeed, one of the healthcare identifiers even tracks the present location for an admitted patient.

Computer A 17 accesses the network 34 at access point 32 and computer B 15 accesses the network 34 at access point 33. As shown, access to the server system is controlled by the EMPI. In such a manner, EMPI identifies those healthcare practitioners authorized to access features of the server system 12 and the practitioner's authorization level. For example, some healthcare practitioners may not be able to access the server system 12 at all, while others may have an ability to review patient medical records, but not financial records, and others may have full rights to all data. Thus, the EMPI tracks who can validly access the system at what authorization level.

To further increase security on the system, the EMPI may also store fingerprint information for each authorized user. In such a manner, during initialization of the system each authorized user has their fingerprints scanned and stored in the EMPI. Then at a later time when the practitioner desires to access the system, the practitioner uses a remote fingerprint reader such as remote fingerprint reader 46 to scan their fingerprint. The scanned fingerprint is compared with the stored fingerprint information in the server system 12. In such a manner, the server system 12 can verify with a high degree of confidence that the practitioner can be trusted.

Each healthcare enterprise generally has more than one facility. For example, the healthcare enterprise of figure 1 has n healthcare facilities 40. Each of the healthcare facilities will be similar to healthcare facility 1, although some facilities may have more, less, or a different mix of functions as compared to healthcare facility 1 38.

Healthcare facility 1 38 is a hospital for providing a point of care for patients. In such a manner the healthcare facility 38 has specialized equipment such as data acquisition device 41 and fetal monitor 42 for

monitoring newborn babies. Associated with the data acquisition device 41 may be a display terminal 43 whereby a healthcare practitioner monitors the data acquisition unit 41 and gains access to the entire computer system, including the server system 12. Specifically, the practitioner at display terminal 43 may need to access the CIS computer system 56 to review or update a treatment plan for the infant on the fetal monitor 42.

However, the CIS computer system for the newborn may be operating at a different facility. For example, the newborn baby on fetal monitor 43 may have been originally admitted to an emergency facility where the emergency facility's CIS was used to establish a treatment plan. As the newborn progressed, he/she may have been moved to facility 1 38, which is remote from the emergency facility. Thus, when the practitioner needs to access, review, and update the CIS treatment plan for the newborn, the practitioner does not access CIS computer system 56, but must access the CIS computer system for the emergency facility. Such access, as will be further discussed, is provided by display terminal 43.

Attached to display terminal 43 is a fingerprint reader 44 for verifying the practitioner and assuring the

practitioner has the necessary authorization to perform the desired function. The fingerprint reader can also be used to assist in positively identifying patients through fingerprint matching. Healthcare facility 38 also has a plurality of nurse's stations with terminals such as nurse's station terminal 45. Each nurse's station terminal has a fingerprint reader 46, again for providing verifications. Bedside terminals 47 may be positioned adjacent patients so that clinical records can be reviewed and updated adjacent patient location. Bedside terminal 47 has fingerprint reader 48 connected thereto for patient identification and practitioner authorization.

Major healthcare facilities also have a laboratory and a pharmacy associated therewith. Therefore, the laboratory will have a laboratory 49 with fingerprint reader 50 and the pharmacy will have a pharmacy terminal 51 with a fingerprint reader 52. In such a manner, laboratory personnel and pharmacy personnel have full access to the CIS computer system 56 and the server system 12. Healthcare facilities also have administration functions for financial, insurance, and admitting purposes. For example, administration terminal 53 has fingerprint reading

54 connected thereto and may be used for admitting patients.

The various terminals and computers within healthcare facility 38 may be interconnected by a network 57. Indeed, network 57 can even be a complete Internet system. The network 57 connects to the server system 12 via network 34.

Other healthcare facilities such as healthcare facility n 40 are part of the healthcare enterprise. Several of these healthcare facilities may have their own CIS computer system operating. These CIS computer systems may be installed and running locally at the healthcare facility such as shown in healthcare facility 38, or the CIS system may be operating remotely on the server system 12 (not shown).

Referring now to FIG. 3 there is shown a method of admitting a patient 120 using the healthcare management system 10 of FIG. 1. As shown in block 121, a patient arrives at one of the healthcare facilities for the healthcare enterprise. A practitioner makes contact in block 122. This contact typically will be by a practitioner entering admitting information into an administrative terminal such as administrative terminal 53 or by an emergency room personnel admitting information

into an emergency room terminal (not shown). The practitioner enters authorization information, such as the practitioner's user name and password into a terminal such as administration terminal 53 as shown in block 124. Other information may be required, such as a challenge security system for further verifying the practitioner.

During the verification process, the practitioner is directed to place his/her finger on a fingerprint reader and the fingerprint reader scans the practitioner's fingerprint as shown in block 126. The use of a fingerprint reader adds significant additional security to the system, but is optionally used. Further, those skilled in the art will recognize other types of security devices may be added. For example, speech patterns and retina scans can also be used for verifying and identifying people.

Referring again to FIG. 3, block 128 shows that the information indicative of the scanned practitioner's fingerprint is compared to the practitioner fingerprint information stored in the EMPI file. In block 130, if the practitioner fails the authorization routine, then the practitioner must reenter or correct the information. Those skilled in the art will recognize that often a user

is given a set number of attempts, such as three attempts, before the system generates an intrusion alert. The practitioner also must be authorized to perform the particular function requested. Here, the practitioner desires to admit a patient. Each practitioner has an authorization level associated therewith which determines what functions they may properly perform in the system. If the practitioner is valid and authorized, then the patient may be properly admitted by that practitioner.

The practitioner then determines if the patient is conscious in block 133. If not conscious, the practitioner collects any available information from other parties such as family members, emergency personnel, or documents retrieved from the patient's body as shown in block 135. If the patient is conscious, then the practitioner can interrogate the patient for basic patient information as shown in block 137. For example, the practitioner will collect patient name, age, birth date, social security, and other data that can positively identify the patient. Block 139 shows that optionally the fingerprint reader can be used to collect a fingerprint scan from the patient. This can be the same fingerprint reader used by the practitioner for verification and authorization. In such a manner, the

scanned patient fingerprint is compared to stored fingerprint information in the EMPI as shown in block 142. Such a fingerprint scan comparison facilities correctly identifying a patient.

The data collected by the practitioner, and the fingerprint scan information, if collected, may not positively identify the patient. Therefore, there may be multiple patients which sufficiently match the collected data that the system cannot automatically make a positive determination based on the collected patient information. Therefore, block 144 shows that the system collects and displays stored patient information for all patients matching the collected patient data. These tentative patients have identifiers sufficiently close to the collected patient data that the practitioner will need to review the additional patient information to determine which patient is actually waiting to be admitted as shown in block 146. This additional patient information can include demographic information such as address, and medical record data. Those skilled in the art recognize other information can be included as additional patient information.

Even though the additional patient information has possibly been collected at multiple enterprise facilities by different CIS computer systems, since each facility's CIS system forwards information to the CDR, the CDR has substantial patient information for the whole enterprise. In such a manner the additional patient information for all tentative patients is quickly and efficiently sent to the practitioner.

After reviewing the additional patient information, if the patient cannot be positively identified, then the practitioner adds the patient to the EMPI as a new patient as indicated in block 151. In such a manner, collected basic patient specific information and the fingerprint scan will be stored in the EMPI for future use. The practitioner then can proceed to establish a CIS treatment plan for the newly added patient as shown in block 155. However, if the practitioner is able to make a positive ID of the patient, then the practitioner selects the positively identified patient from the list of tentative patients as shown in block 153. The practitioner then can proceed to review and use the CIS system to establish the current treatment plan as shown in block 155. Finally, the

EMPI file is updated to reflect that the patient has been admitted and is located at the current facility location.

Referring now to FIG. 5, there is shown a method for finding a patient using the healthcare management system of FIG. 1. FIG. 5 shows in block 161 that a practitioner at a healthcare facility needs to find a patient. The practitioner may believe the person is a currently admitted patient, or may want to get an updated status on an old patient. The practitioner can be located in the same or a different facility from where the patient is located. Indeed, the practitioner may not even know in what facility the patient is presently located.

As described in detail above, the practitioner is verified and authorized as shown in block 163. In block 165, the practitioner enters patient specific data relating to the patient at issue. As described more fully above, the system compares the patient specific data to patient identifier data in the EMPI in block 167 and then collects and displays tentative patients in block 167. The practitioner then can review the tentative patient list in block 170 and select, if displayed, the positively identified patient as shown in blocks 172 and 176. If no such patient can be positively identified, the practitioner

is instructed to enter additional patient data as shown in block 174. However, since the practitioner is attempting to find information on a patient they believe to be admitted or an old patient, the practitioner is likely to have very specific patient identification information such as a patient medical number. In such a manner, the patient identification steps can be abbreviated as the practitioner already has positive ID information on the patient at issue.

The practitioner selects the positively identified patient at issue in block 176. Block 178 shows that the system then displays the identified patient information. Patient information can be included such information as the location information for the patient at issue. Further, the system can show any available patient records and where those records are located. Thereby, the practitioner can quickly locate not only the patient at issue, but all related medical and CIS records for that patient.

At other times the practitioner may desire to access the patient's CIS system to review and update the patient's treatment plan. As briefly discussed earlier, the patient's treatment plan may be on a CIS system at a different facility than where the patient is presently

located. Further, the CIS system may be different from the CIS system where the practitioner resides. For example, an enterprise may have several facilities, with each facility operating an associated CIS system. Since the patient may be at a facility remote from the practitioner, the practitioner's local CIS system has no visibility to the patient's CIS files.

Referring now to FIG. 6 there is shown a method 180 for a practitioner to access the CIS system for any patient in the enterprise. Block 181 shows that the practitioner knows a patient is within the enterprise system and that the practitioner wants to review and adjust the treatment plan for that patient. For example, a remotely located specialist may want to review a patient's medical file and make adjustments to the treatment plan. After validating and authorizing as shown in block 183 and discussed fully above, the practitioner enters minimal patient specific data into a terminal as shown in block 185. For example, the practitioner may simply enter the name of the patient or the patient medical ID number. The patient identification process is simplified as the practitioner is confident the patient is presently under care and is already somewhat familiar with the specifics of the

patient's case. Thus, the risk of mis-identification is minimized.

The system then queries, in parallel, all CIS systems in the enterprise for patient(s) matching the entered patient specific data as shown in lock 187. If no matching patients are found, then block 192 asks the practitioner for additional information. If a positive ID is found in block 189, then the method accesses the CIS system having the patient's treatment plan as shown in block 194. In such a manner, the practitioner accesses a patient's CIS system by simply entering simple ID data irrespective of what facility is operating the CIS system for that patient.

Referring now to FIG. 2 there is shown another healthcare management system made in accordance with the present invention. This multiple enterprise healthcare system 60 not only provides healthcare management tools for the individual enterprise, but enables a sharing of selected information between healthcare enterprises. In such a manner, healthcare may be delivered to a patient in an expedient and efficient manner irrespective of which healthcare facility or healthcare enterprise the patient selects.

The multiple enterprise healthcare system 10 comprises multiple healthcare enterprises such as healthcare enterprises 62, 64, 66 and 68. For example, healthcare enterprise 62 is similar to the healthcare enterprise described in FIG. 1. In such a manner, healthcare enterprise 62 comprises multiple facilities such as facility 1, 69, facility 2, 73, an administration facility 75, a pharmacy facility 77 and other unspecified facilities up to facility x, 78. Healthcare enterprise 62 has financial application solutions 82 operating at its administration facility 75 and pharmacy support software 85 active at its pharmacy facility 77. In such a manner, healthcare enterprise 62 is self sufficient for financial and pharmacy software and therefore will not need to utilize the financial and pharmacy services available from the central server 98. However, information from the financial 82 and pharmacy 85 software will be sent to the CDR 104 and 105 of the server system 98 to facilitate multi-disciplinary decision support.

Healthcare enterprise 64 is, similar to healthcare enterprise 62 and has facility 1 70, facility 2 74 and administration facility 76 operating financial software 83 and other facilities up to facility y 79. However,

healthcare facility 64 does not have any pharmacy facility. Healthcare enterprise 66 is also similar to healthcare enterprises 62 and 64 except that this enterprise operates on a slightly smaller scale. In such a manner, healthcare enterprise 66 has a facility 1 72, a laboratory facility operating lab software 87, and up to a facility z 80. Finally, healthcare enterprise D has only a single facility 72.

Each healthcare enterprise can supplement local healthcare applications by using remotely hosted applications on the server. For example, healthcare facility 1 is not locally operating any laboratory control application. Therefore, healthcare facility 1 may operate remotely the laboratory software operating on the server system 98. In such a manner enterprises may supplement existing capability by simply remotely hosting applications from the server system 98.

None of the healthcare enterprises 62, 64, 66, or 68 are presently running a local facility CIS system. Each of the healthcare enterprises connects to a network 90 via a network connection such as network connection 91, 93, 94 or 95. The network 90 may be any one of several available public or private networks, such as the Internet. For

public networks, additional security becomes necessary. The network 90 connects to the computer server 98 via link 92.

Computer server 98 is similar to server system 12 discussed above and comprises network computers 96 and 98. Server system 98 operates the same suite of healthcare applications as operating on server system 12, except server system 98 has an additional VHCIS/CIS application 100 and 101. This application is for providing CIS functionality for each healthcare facility not having a local facility CIS system. As with server system 12, the EMPI 102 and 103 provide practitioner authorization and patient finding functions.

When installing the multiple enterprise healthcare system, each healthcare enterprise must select how that enterprise will implement CIS systems. For example, the healthcare enterprise can choose to operate CIS on a facility by facility basis. For example, if healthcare enterprise 62 selects to operate CIS on a facility-by-facility basis, facility 1 will have a CIS system which operates separately from the CIS facility for facility 2. To make such a selection, the healthcare enterprise 62 chooses to install CIS in blocks 100 and 101.

In making such a selection, the server system 98 establishes a physically or logically partitioned data base for each facility of the healthcare enterprise. In such a manner, the CIS for each facility operates independent of every other facility. Of course, using the inventive aspects already discussed, practitioners at facility 1 69, for example, can find patient information and access the CIS system for facility 2 73.

However, an enterprise may choose to operate its CIS system on a enterprise wide basis. In such a manner, all facilities in the enterprise operate on the same CIS system. To make such an election, the healthcare enterprise desiring to operate CIS on an enterprise wide basis selects to install VHCIS (virtual hospital clinical information system) in block 100 and 101. If the VHCIS is installed, then the server system 98 establishes a data base for holding all CIS information for all facilities.

Referring now to FIG. 7 there is shown a method of admitting a patient into the multiple enterprise healthcare system as shown in FIG. 2. The method of admitting 200 is similar to method of admitting 120 except the method operates on a network connecting multiple enterprises. In method 200 a patient arrives at a healthcare facility for

any enterprise as shown in block 201. The practitioner performs an authorization routine in blocks 203, 205, 207, 209, and 212 similar to the authorization routines discussed in FIG. 3.

Provided the practitioner is valid and authorized as shown in block 212, then the practitioner proceeds to collect information from the patient in blocks 214, 216, 218 and 220 in a manner similar to that shown in FIG. 3. The collected patient data is compared to the patient identifiers stored in the EMPI in block 223. The EMPI file contains not only patient identifiers for the practitioner's enterprise, but includes patient identifiers from the other networked healthcare enterprises. In such a manner, block 225 shows that tentative patient are selected from all enterprises and displayed for the review of the practitioner in block 227. Thereby, the practitioner not only has visibility to patients of the practitioner's enterprise, but searches other network enterprises for other possible matches. Of course, those skilled in the art will recognize that healthcare information can only be shared between healthcare enterprises pursuant to proper legal authorization for the transfer. Thus, medical data

is only transferred when necessary approvals have been received.

Referring now to FIG. 8, the practitioner selects the positively identified patient in blocks 228 and 233, if displayed. The practitioner adds the patient to the EMPI as a new patient in block 230 if not positively identified. Subsequently, the practitioner can establish CIS data for current treatment of the patient as shown in block 235. Finally, the EMPI file is updated to reflect that the patient is currently admitted into a particular facility location.

Referring now to FIG. 9, there is shown a method of installing the multiple enterprise health system as shown in FIG. 2. Block 241 shows that a plurality of healthcare facilities are connected to a wide area network. Such facilities may be interconnected by an intranet which is then connected to the wide area network, or each facility may have its own connection into the wide area network.

A remote host operates healthcare related applications and each facility is given access to these applications as shown in block 243.

The enterprise must decide if they choose to operate CIS on an enterprise wide basis as shown in block 245. If

the enterprise chooses to install the enterprise wide VHCIS, then block 252 shows that the remotely hosted data base stores CIS data from multiple facilities. As shown on block 253, the VHCIS operates on the remote host, providing CIS services for all facilities.

If the enterprise chooses not to operate enterprise wide CIS, then the enterprise must choose whether they will operate CIS remotely from a computer such as server system 98 or if they will operate CIS locally at each facility. In block 247, if the enterprise chooses to operate CIS remotely, then the remotely host data base is partitioned so that each facility's data is stored in a separate partition of the data base as shown in block 254. For that facility, as indicated in block 255, CIS then operates on the remote host computer system.

However, if the enterprise chooses to locally operate CIS at a facility, then CIS system is installed locally at the facility, as shown in block 248. However, CIS data from the local CIS system is still sent. However, to a repository at the remote host as shown in block 249. Thereby, whether the CIS is operated remotely or locally, the server system 98 stores CIS information for the

enterprise. The enterprise may even choose to operate some facilities remotely and some facilities with local CIS.

Alternatively, an enterprise can elect to operate a subset of facilities using VHCIS, with other facilities operating either remote or local CIS systems. For example, an enterprise may operate all its general hospitals under a single VHCIS, but operate its specialty hospitals, such as a children's hospital, as a separate CIS. In such a manner the general hospitals would be active as VHCIS facilities, while the children's hospital would have a separate local or remote CIS system. Therefore, both CIS and VHCIS would be installed.

Although the preferred embodiment shows the CDR hosted on the server system, the CDR and/or the master index may also be distributed, such as on the local CIS systems.

While particular embodiments of the present invention have been disclosed, it is to be understood that various different modifications are possible and are contemplated within the true spirit and scope of the appended claims. There is no intention, therefore, of limitations to the exact abstract or disclosure herein presented.

CLAIMS

What is claimed is:

1. A method for admitting a patient to a healthcare facility, the healthcare facility being one of plurality of healthcare facilities in a healthcare enterprise, comprising:

generating a master index of patient identifiers, the patient identifiers for providing positive identification;

loading, for patients from each of the plurality of healthcare facilities, patient identifiers into the master index so that the master index includes patient identifiers for patients from the plurality of healthcare facilities;

verifying and authorizing a practitioner to admit the patient;

collecting patient specific data from the patient;

entering the patient specific data into the computer means;

communicating the patient specific data to the server means;

comparing the patient specific data to the patient identifiers stored in the master index on the server means;

selecting one or more tentative patients whose patient identifiers correlate to the patient specific data;

sending, for each selected tentative patient, patient information to the computer means;

reviewing, by the healthcare practitioner, the received patient information to positively identify the patient;

admitting the patient to the healthcare facility;

updating the patient identifier for the patient to reflect the patient is now admitted to the healthcare enterprise; and

updating the patient identifier to reflect the healthcare facility where the patient is located.

2. The method of admitting a patient according to claim 1 wherein the verifying and authorizing step further include:

using a security scan device attached to computer means at an admitting location;

scanning a physical attribute of the healthcare practitioner into the security device;

communicating information indicative of the scan to a server means;

comparing the scan information to authorization information stored in the server means; and

verifying the healthcare practitioner is authorized to admit the patient.

3. The method of admitting a patient according to claim 1 further including scanning with a fingerprint reader the patient's fingerprint and comparing the scanned fingerprint to fingerprint information stored in the master index to facilitate positively identifying the patient.

4. The method of admitting a patient according to claim 1 wherein the patient information is stored in the master index and includes demographic information and medical record number data.

5. The method of admitting a patient according to claim 1 wherein the enterprise is networked to another healthcare enterprise, and the master index is loaded to include patient identifiers received from the other healthcare enterprise so that the selected tentative

patients include patients of the other healthcare enterprise.

6. A method for locating an admitted patient within a healthcare enterprise, the patient being admitted at one of a plurality of enterprise facilities, comprising:

generating a master index of patient identifiers, the patient identifiers for providing positive identification;

loading, for patients from each of the plurality of healthcare facilities, patient identifiers into the master index so that the master index includes patient identifiers for patients from the plurality of healthcare facilities;

verifying and authorizing a practitioner to locate the admitted patient;

entering patient specific data for the admitted patient into the computer means;

communicating the patient specific data to the server means;

comparing the patient specific data to the patient identifiers stored in the master index on the server means;

selecting one or more tentative patients whose patient identifiers correlate to the patient specific data;

sending, for each selected tentative patient, patient information to the computer means;

reviewing, by the healthcare practitioner, the received patient information to positively identify the patient;

selecting the positively identified admitted patient; and

viewing the patient information for the admitted patient to determine where the admitted patient is presently located.

7. The method of finding a patient according to claim 6 wherein the patient information for the admitted patient further includes file location information.

8. The method of finding a patient according to claim 6 wherein the verifying and authorizing step further include:

using a security scan device attached to computer means at an admitting location;

scanning a physical attribute of the healthcare practitioner into the security device;

communicating information indicative of the scan to a server means;

comparing the scan information to authorization information stored in the server means; and

verifying the healthcare practitioner is authorized to admit the patient.

9. The method of finding a patient according to claim 6 wherein the patient information is stored in the master index and includes demographic information and medical record number data.

10. The method of finding a patient according to claim 6 wherein the enterprise is networked to another healthcare enterprise, and the master index is loaded to include patient identifiers received from the other healthcare enterprise so that the selected tentative patients include patients of the other healthcare enterprise.

11. A method of using a facility treatment plan system for a healthcare facility, the healthcare facility being one of a plurality of healthcare facilities in a healthcare enterprise, the plurality of healthcare facilities each operating a treatment plan system, comprising:

validating and authorizing a practitioner at a remote enterprise facility to access the facility treatment plan system;

providing terminal means at the remote facility;

entering, by the practitioner, minimal patient specific data into the terminal means;

transmitting the minimal patient specific data to each operating treatment plan system to query all the enterprise treatment plan systems;

identifying which treatment plan system is operating a treatment plan for a patient corresponding to the entered minimal patient specific data;

accessing, with the terminal, the identified treatment plan system; and

using, by the practitioner, the treatment plan system to perform a healthcare action on the patient treatment plan.

12. The method of using a facility treatment plan system according to claim 11 wherein the verifying and authorizing step further include:

using a security scan device attached to the terminal;

scanning a physical attribute of the healthcare practitioner into the security device;

communicating information indicative of the scan to a server means;

comparing the scan information to authorization information stored in the server means; and

verifying the healthcare practitioner is authorized to admit the patient.

13. The method of using a facility treatment plan system according to claim 11 wherein the minimal patient specific data is the admitted patient's name.

14. A method of activating treatment plan means for a healthcare enterprise, the enterprise having a plurality of healthcare facilities, comprising:

providing computer means for each of the plurality of healthcare facilities, the facilities being part of the healthcare enterprise;

networking the computer means to a server means, the server means operating a suite of health care applications;

generating a master index of patient identifiers, the patient identifiers for providing positive identification;

loading, for patients from the plurality of healthcare facilities, patient identifiers into the master index so that the master index includes patient identifiers for patients from the plurality of healthcare facilities;

establishing a repository for storing healthcare information from the plurality of healthcare facilities;

establishing an authorization index for validating and approving practitioner access to the application suite and the repository;

selecting which of the plurality of facilities are to operate a unified treatment plan system; and

installing, for the selected facilities, a VHCIS treatment plan system on the server means.

15. The method of activating treatment plan means according to claim 14 further including installing a CIS treatment plan system on the server means for a facility not selected to operate the unified treatment plan system.

16. The method of activating treatment plan means according to claim 15 wherein the CIS treatment plan system further includes installing a partitioned database for storing CIS information.

17. The method of activating treatment plan means according to claim 16 wherein the database is logically partitioned.

18. The method of activating treatment plan means according to claim 16 wherein the database is logically partitioned.

19. The method of activating treatment plan means according to claim 14 further including installing a local CIS treatment plan system at a facility not selected to operate the unified treatment plan system.

20. The method of activating treatment plan means according to claim 14 wherein the master index is on the server means.

21. The method of activating treatment plan means according to claim 14 wherein the repository is on the server means.

22. The method of activating treatment plan means according to claim 14 wherein the authorization index is incorporated into the master index.

23. The method of activating treatment plan means according to claim 14 wherein the master index is distributed on the network.

24. The method of activating treatment plan means according to claim 14 wherein the repository is distributed on the network.

25. The method of activating treatment plan means according to claim 14 wherein the enterprise is networked to another healthcare enterprise, and the master index is

loaded to include patient identifiers received from the other healthcare enterprise.

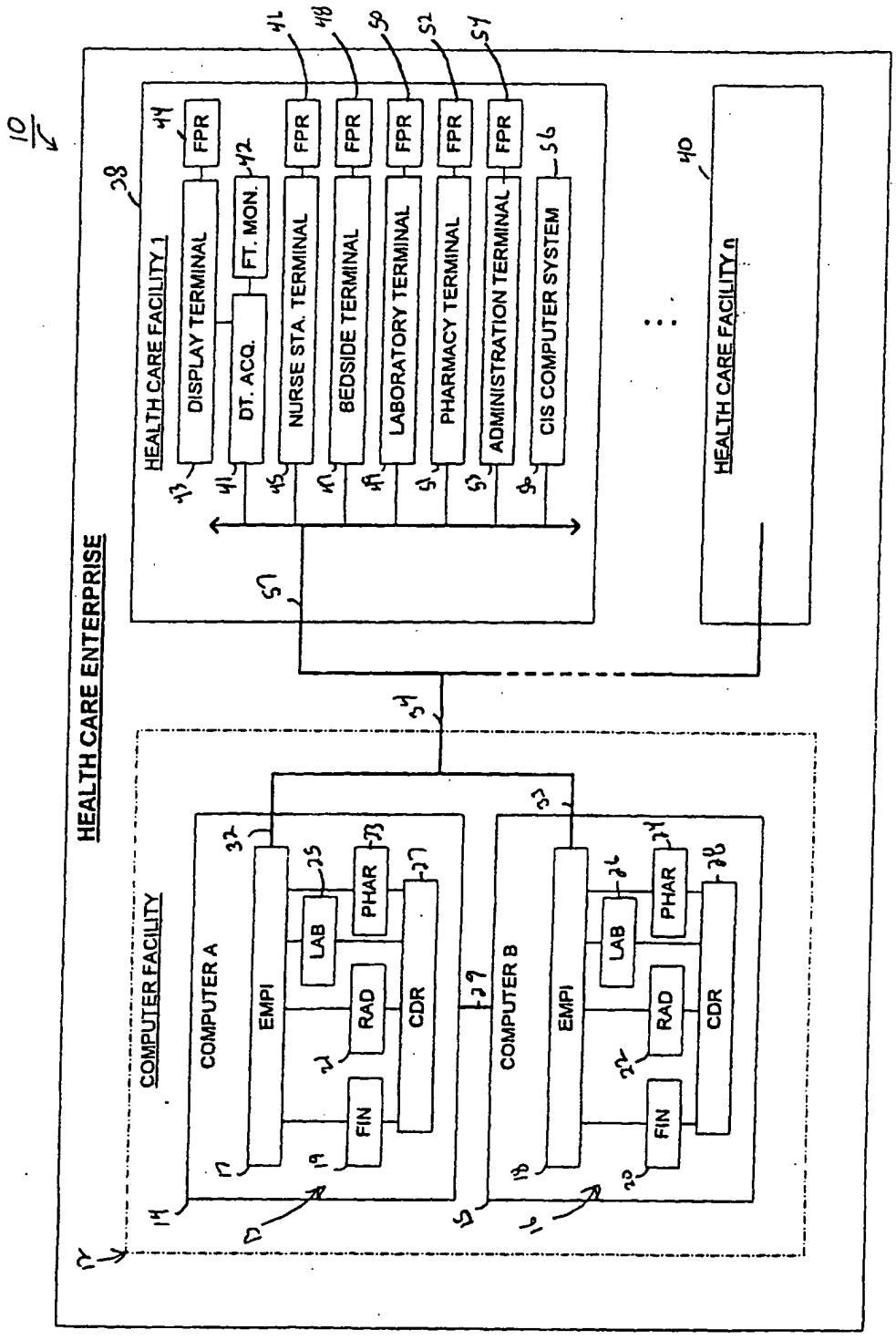

10
HEALTH CARE ENTERPRISE
HEALTH CARE FACILITY 1
DISPLAY TERMINAL
DT. ACQ.
FT. MON.
NURSE STA. TERMINAL
BEDSIDE TERMINAL
LABORATORY TERMINAL
PHARMACY TERMINAL
ADMINISTRATION TERMINAL
CIS COMPUTER SYSTEM
FPR
HEALTH CARE FACILITY n
COMPUTER FACILITY
COMPUTER A
COMPUTER B
EMPI
LAB
PHAR
RAD
CDR
FIN

FIG. 1

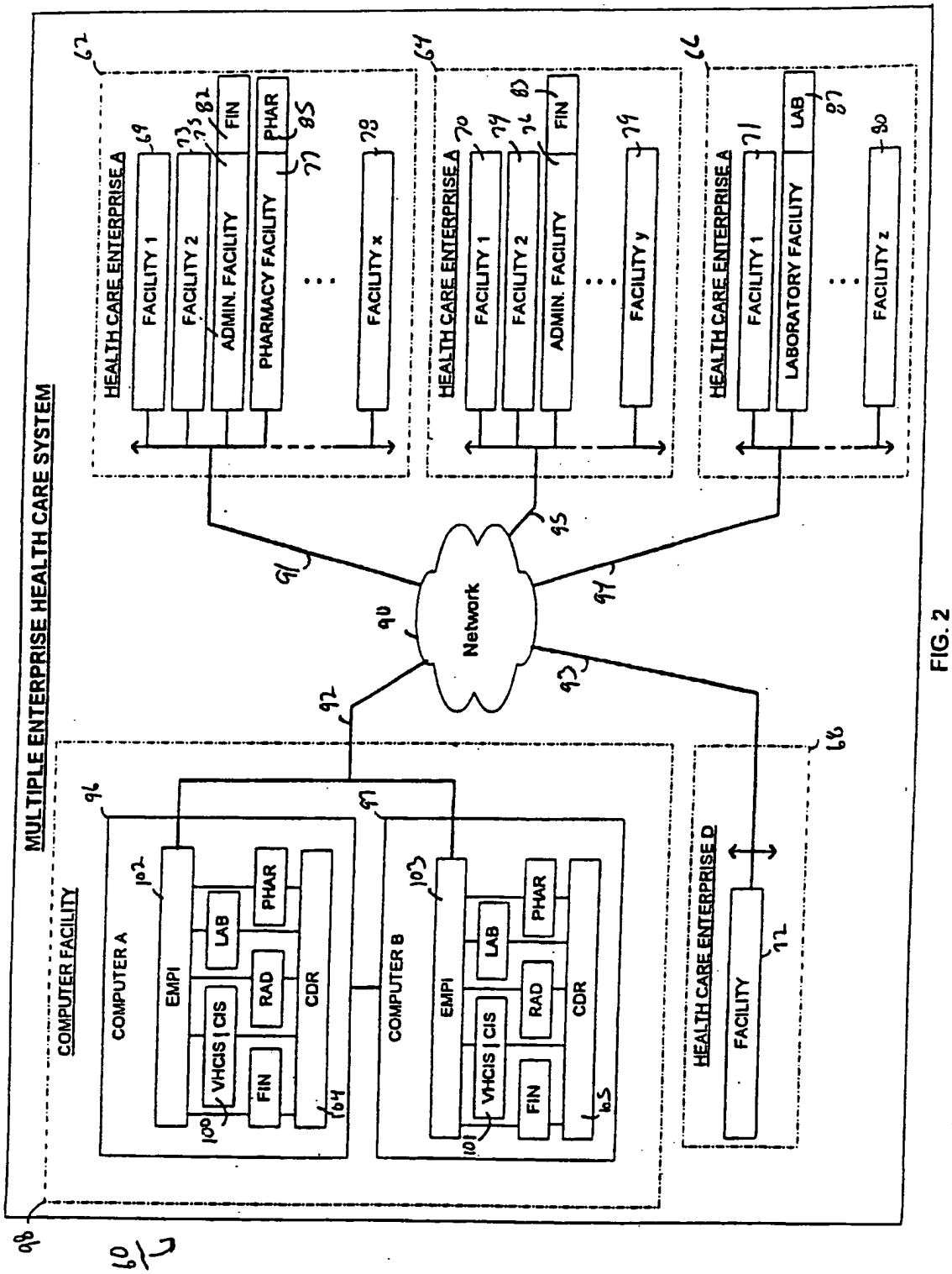

MULTIPLE ENTERPRISE HEALTH CARE SYSTEM
HEALTH CARE ENTERPRISE A
FACILITY 1
FACILITY 2
ADMIN. FACILITY
PHARMACY FACILITY
FACILITY x
FIN
PHAR
HEALTH CARE ENTERPRISE A
FACILITY 1
FACILITY 2
ADMIN. FACILITY
FACILITY y
FIN
HEALTH CARE ENTERPRISE A
FACILITY 1
LABORATORY FACILITY
FACILITY z
LAB
Network
COMPUTER FACILITY
COMPUTER A
EMPI
LAB
PHAR
VHCIS | CIS
RAD
CDR
FIN
COMPUTER B
EMPI
LAB
PHAR
VHCIS | CIS
RAD
CDR
FIN
HEALTH CARE ENTERPRISE D
FACILITY

FIG. 2

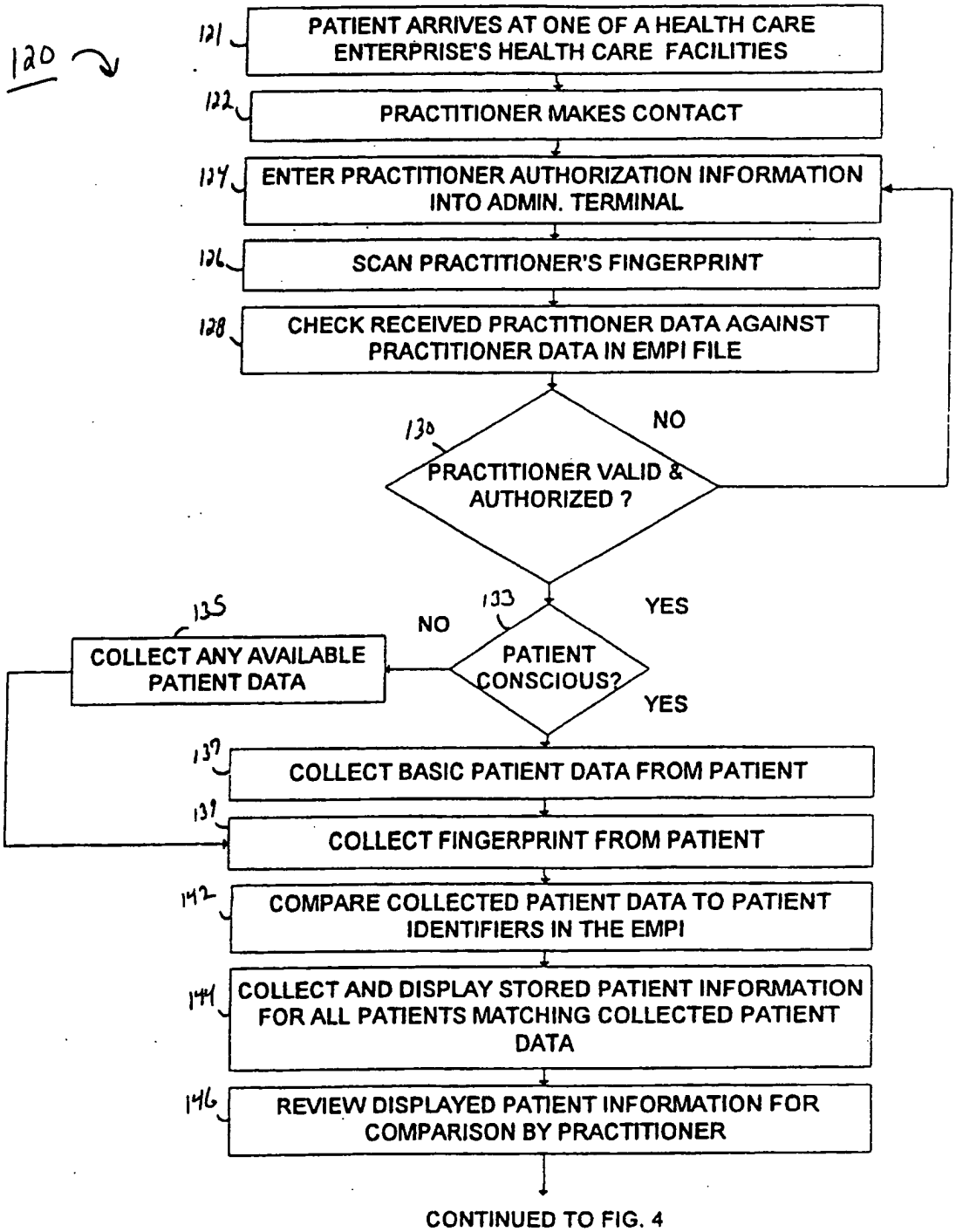

120
121
PATIENT ARRIVES AT ONE OF A HEALTH CARE ENTERPRISE'S HEALTH CARE FACILITIES
122
PRACTITIONER MAKES CONTACT
124
ENTER PRACTITIONER AUTHORIZATION INFORMATION INTO ADMIN. TERMINAL
126
SCAN PRACTITIONER'S FINGERPRINT
128
CHECK RECEIVED PRACTITIONER DATA AGAINST PRACTITIONER DATA IN EMPI FILE
130
PRACTITIONER VALID & AUTHORIZED ?
NO
YES
133
PATIENT CONSCIOUS?
NO
YES
135
COLLECT ANY AVAILABLE PATIENT DATA
137
COLLECT BASIC PATIENT DATA FROM PATIENT
139
COLLECT FINGERPRINT FROM PATIENT
142
COMPARE COLLECTED PATIENT DATA TO PATIENT IDENTIFIERS IN THE EMPI
144
COLLECT AND DISPLAY STORED PATIENT INFORMATION FOR ALL PATIENTS MATCHING COLLECTED PATIENT DATA
146
REVIEW DISPLAYED PATIENT INFORMATION FOR COMPARISON BY PRACTITIONER
CONTINUED TO FIG. 4

FIG. 3

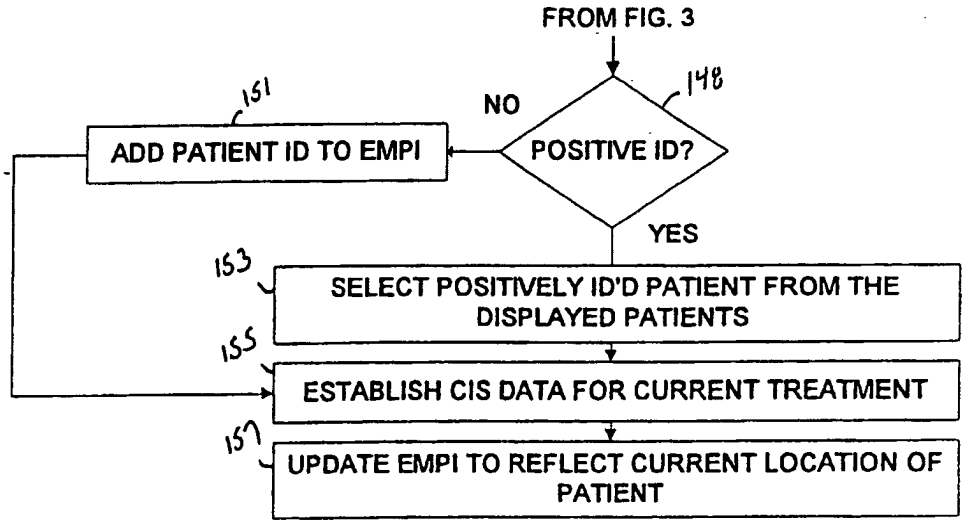

FROM FIG. 3
148
NO
151
ADD PATIENT ID TO EMPI
POSITIVE ID?
YES
153
SELECT POSITIVELY ID'D PATIENT FROM THE DISPLAYED PATIENTS
155
ESTABLISH CIS DATA FOR CURRENT TREATMENT
157
UPDATE EMPI TO REFLECT CURRENT LOCATION OF PATIENT

FIG. 4

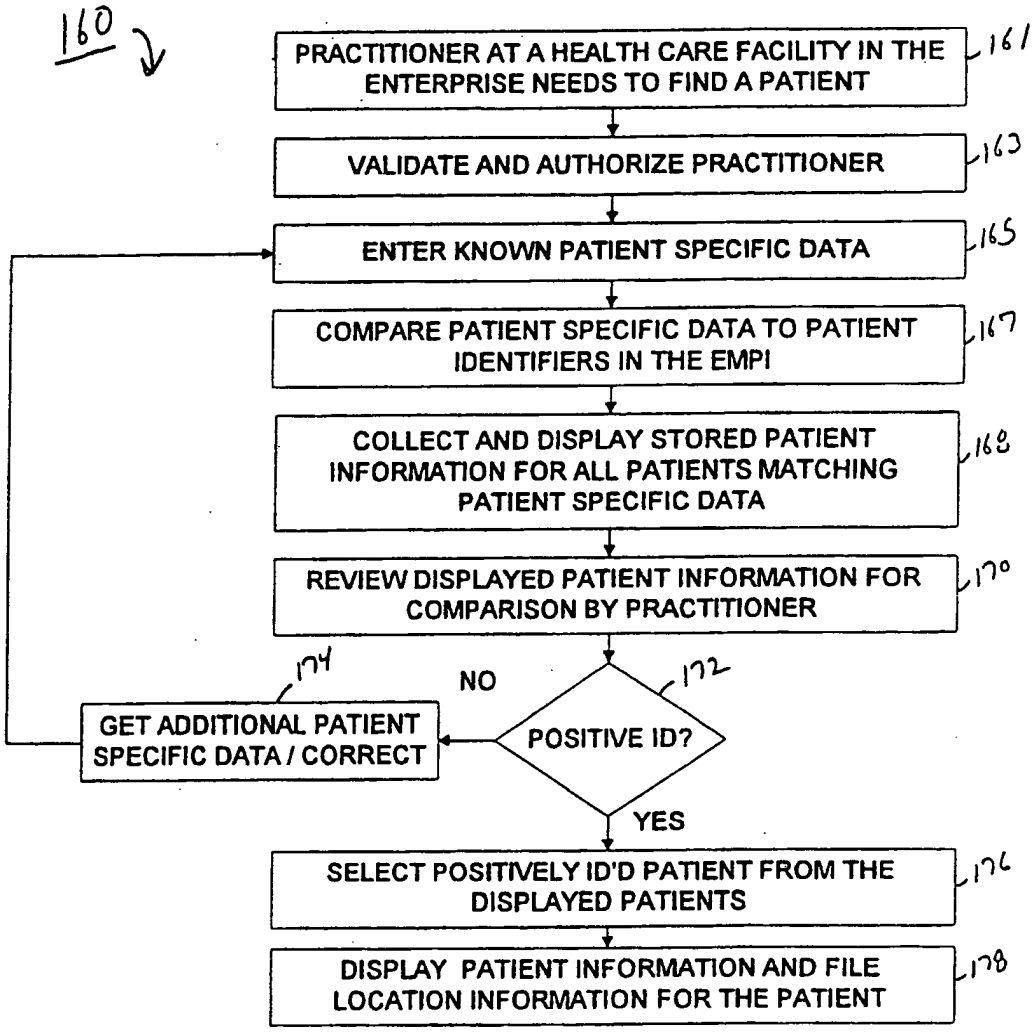

160
PRACTITIONER AT A HEALTH CARE FACILITY IN THE ENTERPRISE NEEDS TO FIND A PATIENT
161
VALIDATE AND AUTHORIZE PRACTITIONER
163
ENTER KNOWN PATIENT SPECIFIC DATA
165
COMPARE PATIENT SPECIFIC DATA TO PATIENT IDENTIFIERS IN THE EMPI
167
COLLECT AND DISPLAY STORED PATIENT INFORMATION FOR ALL PATIENTS MATCHING PATIENT SPECIFIC DATA
168
REVIEW DISPLAYED PATIENT INFORMATION FOR COMPARISON BY PRACTITIONER
170
POSITIVE ID?
172
NO
GET ADDITIONAL PATIENT SPECIFIC DATA / CORRECT
174
YES
SELECT POSITIVELY ID'D PATIENT FROM THE DISPLAYED PATIENTS
176
DISPLAY PATIENT INFORMATION AND FILE LOCATION INFORMATION FOR THE PATIENT
178

FIG. 5

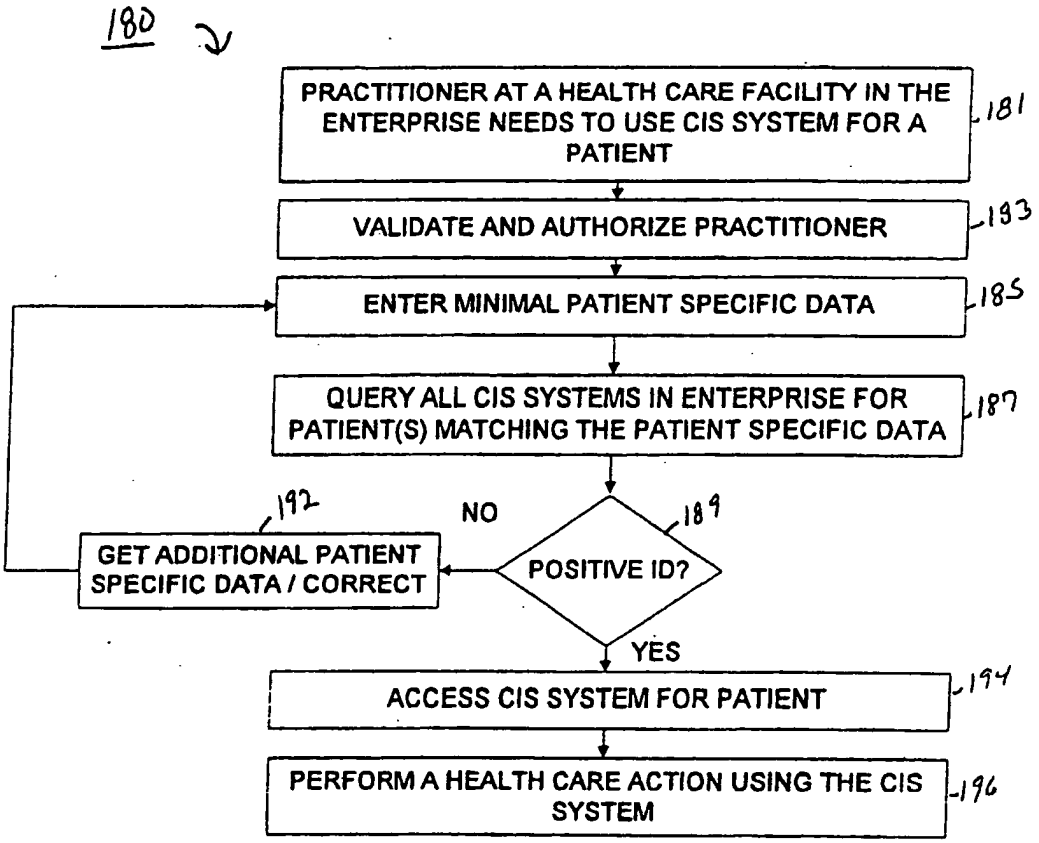

180
PRACTITIONER AT A HEALTH CARE FACILITY IN THE ENTERPRISE NEEDS TO USE CIS SYSTEM FOR A PATIENT
181
VALIDATE AND AUTHORIZE PRACTITIONER
183
ENTER MINIMAL PATIENT SPECIFIC DATA
185
QUERY ALL CIS SYSTEMS IN ENTERPRISE FOR PATIENT(S) MATCHING THE PATIENT SPECIFIC DATA
187
POSITIVE ID?
189
NO
GET ADDITIONAL PATIENT SPECIFIC DATA / CORRECT
192
YES
ACCESS CIS SYSTEM FOR PATIENT
194
PERFORM A HEALTH CARE ACTION USING THE CIS SYSTEM
196

FIG. 6

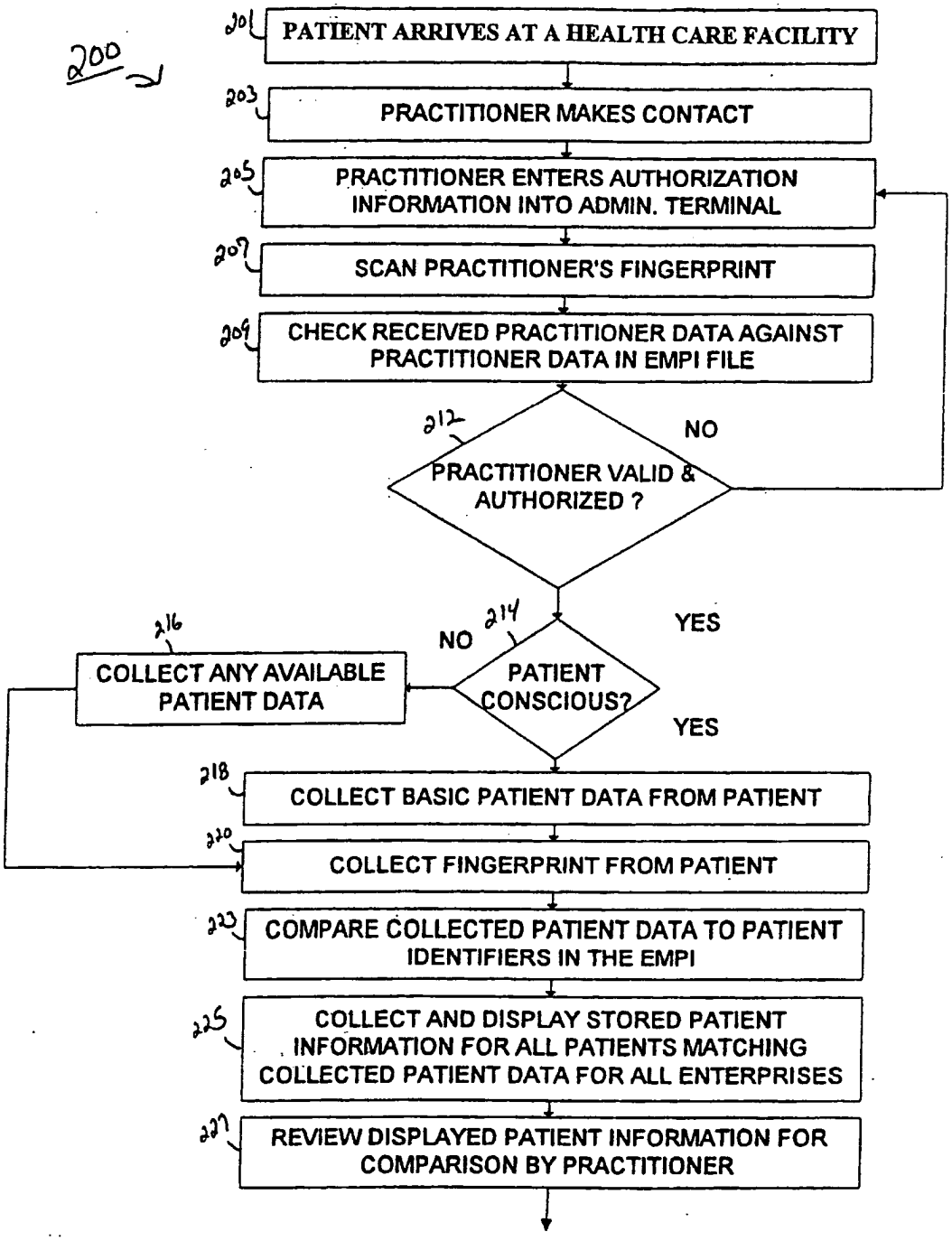

200
201
PATIENT ARRIVES AT A HEALTH CARE FACILITY
203
PRACTITIONER MAKES CONTACT
205
PRACTITIONER ENTERS AUTHORIZATION INFORMATION INTO ADMIN. TERMINAL
207
SCAN PRACTITIONER'S FINGERPRINT
209
CHECK RECEIVED PRACTITIONER DATA AGAINST PRACTITIONER DATA IN EMPI FILE
212
PRACTITIONER VALID & AUTHORIZED ?
NO
YES
214
PATIENT CONSCIOUS?
NO
YES
216
COLLECT ANY AVAILABLE PATIENT DATA
218
COLLECT BASIC PATIENT DATA FROM PATIENT
220
COLLECT FINGERPRINT FROM PATIENT
223
COMPARE COLLECTED PATIENT DATA TO PATIENT IDENTIFIERS IN THE EMPI
225
COLLECT AND DISPLAY STORED PATIENT INFORMATION FOR ALL PATIENTS MATCHING COLLECTED PATIENT DATA FOR ALL ENTERPRISES
227
REVIEW DISPLAYED PATIENT INFORMATION FOR COMPARISON BY PRACTITIONER
CONTINUED TO FIG. 8

FIG. 7

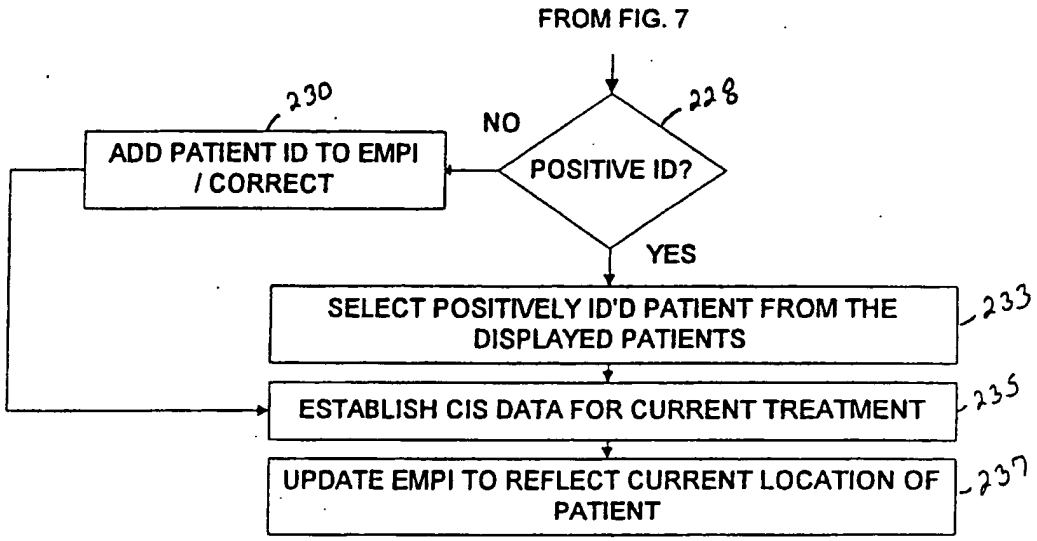

FROM FIG. 7
228
POSITIVE ID?
NO
230
ADD PATIENT ID TO EMPI / CORRECT
YES
SELECT POSITIVELY ID'D PATIENT FROM THE DISPLAYED PATIENTS
233
ESTABLISH CIS DATA FOR CURRENT TREATMENT
235
UPDATE EMPI TO REFLECT CURRENT LOCATION OF PATIENT
237

FIG. 8

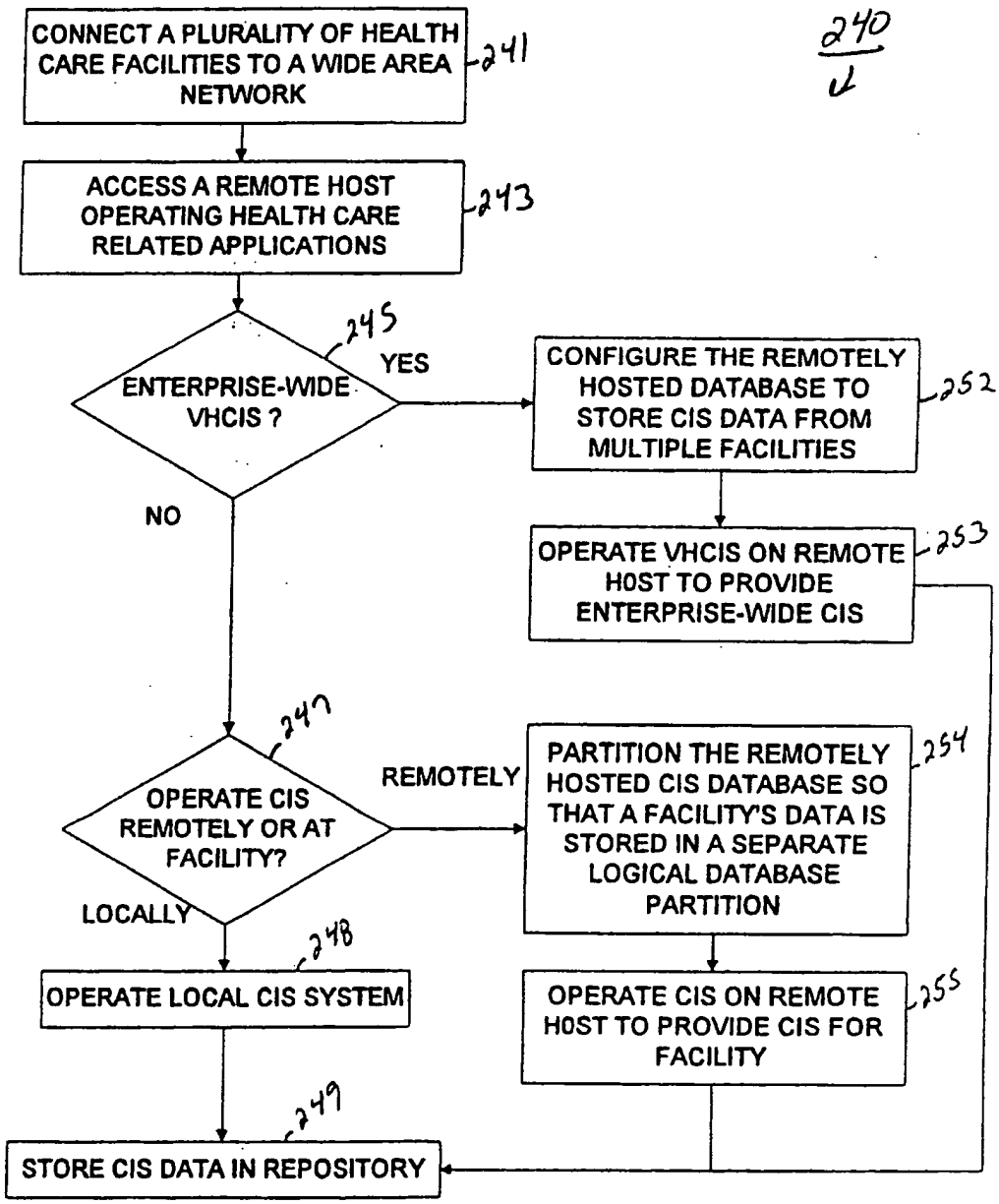

240
CONNECT A PLURALITY OF HEALTH CARE FACILITIES TO A WIDE AREA NETWORK
241
ACCESS A REMOTE HOST OPERATING HEALTH CARE RELATED APPLICATIONS
243
ENTERPRISE-WIDE VHCIS ?
245
YES
CONFIGURE THE REMOTELY HOSTED DATABASE TO STORE CIS DATA FROM MULTIPLE FACILITIES
252
NO
OPERATE VHCIS ON REMOTE HOST TO PROVIDE ENTERPRISE-WIDE CIS
253
OPERATE CIS REMOTELY OR AT FACILITY?
247
REMOTELY
PARTITION THE REMOTELY HOSTED CIS DATABASE SO THAT A FACILITY'S DATA IS STORED IN A SEPARATE LOGICAL DATABASE PARTITION
254
LOCALLY
OPERATE LOCAL CIS SYSTEM
248
OPERATE CIS ON REMOTE HOST TO PROVIDE CIS FOR FACILITY
255
STORE CIS DATA IN REPOSITORY
249

FIG. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/16686

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :GO6F 159:00
US CL :705/3

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 705/2, 3; 707/2, 3, 10, 100

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,193,855 A (SHAMOS) 16 MARCH 1993, COLUMN 2, LINES 9-37 AND COLUMN 5 , LINES7-47.	1-25
Y	US 5,262,943 A (THIBADO ET AL) 16 NOVEMBER 1993, COLUMN 7, LINE 5 TO COLUMN 12, LINE 40.	1, 6
Y	US 5,781,442 A (ENGLESON ET AL) 14 JULY 1998, COLUMN 12, LINE 7 TO COLUMN 15, LINE 32.	1-25
Y	US 5,845,253 A (RENSIMER ET AL) 01 DECEMBER 1998, COLUMN 3, LINE 10 TO COLUMN 7, LINE 38.	1, 6

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 07 AUGUST 2000	Date of mailing of the international search report 29 AUG 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer FRANTZY POINVIL Telephone No. (703) 305-9707

Form PCT/ISA/210 (second sheet) (July 1998)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/16686

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y,P	US 6,005,962 A (HIROTA ET AL.) 21 DECEMBER 1999, COLUMN 3, LINE 44 TO COLUMN 5, LINE 40.	1-25